Printed on Thin Paper for Foreign Circulation.
"THE ENGINEER," JUNE 20, 1924.

JUN 30 1924

BRITISH EMPIRE EXHIBITION NUMBER—No. 9.

Engineering Library

The Engineer.

Established 1856.

Registered as a Newspaper.

OFFICE FOR ADVERTISEMENTS & PUBLICATION, 33, NORFOLK ST., STRAND, LONDON, W.C. 2.

VOL. CXXXVII.—No. 3573] LONDON: FRIDAY EVENING, JUNE 20, 1924 [PRICE ONE SHILLING BY INLAND POST 1s. 3d.

The Engineer

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PUBLIC NOTICES

The Director-General, India Store Department, Branch No. 15, Belvedere-road, Lambeth, S.E. 1, REQUIRES—
COPPER TUBING, SOLID DRAWN.
Tenders due on the 11th July, 1924.
Tender forms obtainable from above. 6111

Assistant Engineers (4) REQUIRED by the GOVERNMENT of the GOLD COAST, for the PUBLIC WORKS DEPARTMENT, for two tours of 12 to 16 months' service, with possible extension. Salary £480 for the first three years of service and then £516, rising to £720 a year by annual increments of £30, and thence to £920 by annual increments of £40. Outfit allowance of £60 on first appointment. Free quarters and passage and liberal leave on full salary. Candidates, aged 27 to 35, preferably single, should have had considerable experience on road and bridge work, including construction of reinforced concrete bridges and culverts, tar-macadam and tar-sprayed metalled roads. A.M.I.C.E. preferred, and should be able to ride a motor bicycle.—Apply at once, in writing, stating age and giving brief details of experience to the CROWN AGENTS FOR THE COLONIES, 4, Millbank, London, S.W. 1, quoting clearly at head of application M/12,889. 6108

Assistant Locomotive SUPERINTENDENT REQUIRED for the NIGERIAN GOVERNMENT RAILWAY for one tour of from 12 to 18 months' service, with prospect of permanency. Salary £480 a year for the first three years, then £516, rising by annual increments of £30 to £720, and thence by annual increments of £40 to £920. Outfit allowance of £60 on first appointment. Free quarters and first-class passages and liberal leave on full salary. Candidates, age 25 to 35, should be of good education and preferably possess an approved Engineering Diploma. They should have served an apprenticeship in the locomotive workshops of a British railway and have had experience on the footplate and in fitting, turning and erecting, and in the pattern shop, foundry, and drawing-office. They must have had running experience and should be conversant with running shed procedure and breakdown work.—Apply at once, by letter, stating age and particulars of experience, and mentioning this paper, to the CROWN AGENTS FOR THE COLONIES, 4, Millbank, Westminster, S.W. 1, quoting M/Nig. 12,614. 6078

The Institution of Structural ENGINEERS.
EXAMINATIONS FOR GRADUATESHIP AND ASSOCIATE-MEMBERSHIP.
The next EXAMINATIONS for GRADUATESHIP and ASSOCIATE-MEMBERSHIP of the Institution will be held in LONDON, SALFORD (Manchester), and such other centres as may be arranged, on WEDNESDAY, THURSDAY, and FRIDAY, the 2nd, 3rd, and 4th JULY.
The closing date for entries is Wednesday, the 25th June.—A syllabus and entry form may be obtained from the SECRETARY of the Institution of Structural Engineers, 231, Abbey House, Westminster, S.W. 1. 6095

The University of Sheffield
ASSISTANT LECTURESHIP IN MATHEMATICS.
The Council are about to APPOINT an ASSISTANT LECTURER in MATHEMATICS, preference to be given to a candidate who has had experience with engineering students. Salary £250 per annum. Further particulars may be obtained from the undersigned, with whom applications should be lodged by July 7th.
W. M. GIBBONS,
6073 Registrar.

Aberdeen Corporation Water- WORKS.
EXTENSIONS 1920.
CONTRACT NO. 20.—AIRY HALL SERVICE RESERVOIR.
The Town Council of Aberdeen are prepared to receive TENDERS from competent persons willing to enter into a contract for the CONSTRUCTION of a CONCRETE COVERED SERVICE RESERVOIR of a capacity of 7 million gallons at Airy Hall, near Aberdeen.
The drawings may be inspected and specification, schedule of quantities and form of Tender obtained, on and after 27th June, 1924, on application at the Water Engineer's Office, 41½, Union-street, Aberdeen. Early application is desirable and no specification will be given out after 5th July.
For each specification a deposit of Five Pounds sterling will be required, which sum will, after a Tender has been accepted, be returned to the tenderer, provided that he shall have sent in a bona fide Tender, based on the drawings, specification and schedule of quantities provided, with the schedule of quantities fully priced out in detail, and shall not have withdrawn the same.
The employment of labour shall be in accordance with the revised conditions of the Unemployment Grants Committee.
Tenders, on the forms prescribed and enclosed in securely sealed envelopes, endorsed "Tender for Airy Hall Reservoir," are to be addressed to the undersigned. No Tender delivered after Noon on 10th July, 1924, will be considered.
The Town Council do not bind themselves to accept the lowest or any Tender.
GEORGE MITCHELL, M. Inst. C.E., F.G.S.
Water Engineer's Office,
41½, Union-street, Aberdeen.
17th June, 1924. 6093

Bombay, Baroda, and Central INDIA RAILWAY.
The Directors are prepared to receive up to Noon on Wednesday, 9th July, TENDERS for the SUPPLY of :
GIRDER BRIDGES (100ft. Spans).
Tenders must be made on forms, copies of which, with specification, can be obtained at these offices on payment of 20s. each (which will not be returned).
The Directors do not bind themselves to accept the lowest or any Tender.
S. G. S. YOUNG,
Secretary.
Offices: 61, Petty France, Westminster, S.W.1,
16th June, 1924. 6070

Corporation of the City of AUCKLAND, NEW ZEALAND.
QUARRY PLANT.—MOTORS, CRUSHERS, &c.
The above Corporation invite TENDERS for the SUPPLY of PORTION or the WHOLE of the following PLANT :—
(1) A Large JAW CRUSHER, capable of dealing with 1½ cwt. spawls (columnar basalt) and reducing same to 3in. and less at the rate of 250 cubic yards per day of 8 hours.
(2) TWO JAW CRUSHERS, each capable of reducing 125 cubic yards of 5in. spawls to 2½in. and less per day of 8 hours.
(3) ONE or TWO DISC CRUSHERS, capable of dealing with 120 cubic yards of 2in. to 4in. spawls and reducing same to ½in. and less per day of 8 hours.
(4) ONE BELT-DRIVEN AIR COMPRESSOR, capable of supplying 200 cubic feet of free air (working pressure 100 lb. per square inch).
(5) FIVE THREE-PHASE ELECTRIC MOTORS, 400 volts, 50 cycles, on adjustable rail beds, to drive the above.
Specifications and full particulars may be seen at Room 40, New Zealand Government Office, 415, Strand, W.C. 2, on and after Monday, June 23rd, and for the purpose of supplying information the Assistant City Engineer of Auckland may be consulted at the above office between the hours of 11 a.m. and 1 p.m. on Monday, June 30th, Tuesday and Wednesday, July 1st and 2nd.
Sealed Tenders, endorsed "Tenders for Crusher Plant," to be addressed
Mr. James Tyler,
c/o New Zealand Government Office,
415, Strand, London, W.C. 2,
not later than Twelve Noon, Thursday, July 10th, 1924.
The Corporation reserves the right to accept a Tender for the whole or portion of the plant quoted for, and it does not bind itself to accept the lowest or any Tender.
(Sgd.) J. TYLER,
Assistant City Engineer.
Office of the High Commissioner for New Zealand,
415, Strand, London, W.C. 2,
June 14th, 1924. 6061

East Indian Railway.
The Directors are prepared to receive up to 11 a.m. on Wednesday, the 2nd July proximo, TENDERS for the SUPPLY of :—
BUFFERS FOR WAGONS.
Copies of the specification can be obtained at the Company's offices on payment of £1 1s. each. This fee will not be returned.
G. E. LILLIE,
Secretary.
73-76, King William-street, London, E.C. 4,
16th June, 1924. 6107

Kingsbridge Terminus,
17th June, 1924.

The Directors of the Great Southern and Western Railway are prepared to receive TENDERS for the RECONSTRUCTION of the DESTROYED PORTION of the ROAD BRIDGE over the River Suir at Fiddown.
Copies of the specification and drawings can be obtained on and after 23rd inst. from the Company's Chief Engineer, Inchicore, Dublin, on payment of a fee of One Guinea, which will be returned on receipt of a bona fide Tender accompanied by the drawings and specification.
Tenders should be posted so as to reach the undersigned not later than 10 a.m. on July 15th, and should be enclosed in sealed envelopes, endorsed "Tender for Fiddown Bridge."
The Directors do not bind themselves to accept the lowest or any Tender.
C. E. RILEY,
6106 Secretary.

Eastbourne Rural District COUNCIL.
FOR SALE.
At No. 2 Pumping Station, Pevensey, Sussex :—
2 DYNAMOS, by Drake and Gorham, Ltd., 400 volt, 44 amps., at 900 revolutions, and large DOUBLE SWITCHBOARD.
2 ELECTRIC MOTORS, by Drake and Gorham, Ltd., 14 H.P. at 1400 revolutions, complete with resistance coils.
About 1 MILE of TWIN CABLE, 7 by 14 gauge wires in each cable, with braided insulation.
About 1 MILE of BRAIDED INSULATED CABLE, 7 by 16 gauge wires.
About 2 MILES of GALVANISED WIRE for holding above cables with hangers for same.
22 POLES, with brackets and insulators.
1 ELECTRIC SIGNAL BELL with 44in. gong.
Now lying at No 2 Pumping Station at Fence Bridge, Pevensey; wires run along railway between Nos. 2 and 3 Pumping Stations.
Purchasers to take down and remove the whole of the plant and make good all damage to buildings and property caused by removal.
Appointments to view should be made with Mr. H. French, Fence Bridge Pumping Station, Pevensey, Sussex.
The description of the plant and cable is believed to be correct, but tenderers having had the opportunity of inspecting shall not be entitled to make any claim against the Council if there should be any misdescription in the above particulars.
The Council do not bind themselves to accept the highest or any Tender.
Sealed Tenders, marked "Pumping Station," to be deposited with me, the undersigned, not later than Twelve Noon, 1st July, 1924.
R. W. FOVARGUE,
Clerk to the Council.
Avenue House, Eastbourne,
17th June, 1924. 6091

Ilfracombe Urban District COUNCIL.
TENDERS are INVITED for the SUPPLY and DELIVERY of a 16in. STONE BREAKER fitted with ROTARY SCREEN.
Full particulars may be obtained from the undersigned.
Tenders, endorsed and addressed to H. G. Brede, Esq., Town Clerk, Town Hall, Ilfracombe, will be received not later than Noon on Monday, June 23rd, 1924.
FRED. B. GOODMAN,
6023 Engineer and Surveyor.

Ilfracombe Urban District COUNCIL.
TENDERS are INVITED for the SUPPLY and DELIVERY of a TEN-TON STEAM ROLLER. Further particulars may be obtained from the undersigned.
Tenders, endorsed and addressed to H. G. Brede, Esq., Town Clerk, Town Hall, Ilfracombe, will be received not later than Noon on Monday, June 23rd, 1924.
FRED B. GOODMAN,
6024 Engineer and Surveyor.

The Great Indian Peninsula RAILWAY COMPANY, 48, Copthall-avenue, London, E.C. 2, invite TENDERS for :—

1. MILD STEEL BARS	Fee 2s. 6d.
2. WICKS	„ 2s. 6d.
3. SEAMING CORD, &c.	„ 2s. 6d.
4. HELICAL SPRINGS	„ 5s.
5. GALVANISED WROUGHT IRON WATER TUBES, &c.	„ 7s. 6d.

Tenders are due by 11 a.m. on 1st July, 1924. Tender forms obtainable at above address. Fees not returnable. 6096

PUBLIC NOTICES

Lochaber Water Power. CONTRACT NO. 1.
The BRITISH ALUMINIUM COMPANY, Limited, is prepared to receive TENDERS for the CONSTRUCTION of a REINFORCED CONCRETE PIER and APPROACH VIADUCT and WORKS connected therewith at Fort William, Inverness-shire.
Persons desiring to Tender may obtain, on and after the 23rd June, 1924 from the Company's Engineers, Messrs. S. S. Meik and Buchanan, 16, Victoria-street, Westminster, S.W. 1, copies of the drawings, specification form of Tender, &c., upon payment of £5 (by cheque), which will be returned upon receipt of a bona fide Tender, together with the drawings supplied.
Preference will be given to contractors on the King's Roll and who are prepared to employ 75 per cent. of ex-Service men.
Sealed Tenders, endorsed "Lochaber Water Power, Contract No. 1," addressed to the Secretary, 109 Queen Victoria-street, E.C. 4, must be received before 10 a.m. on Monday, 21st July, 1924.
The Company does not bind itself to accept the lowest or any Tender.
G. W. JEFFERY,
6094 Secretary.

Metropolitan Water Board.
MAIN, CRICKLEWOOD TO MARBLE ARCH.
TENDERS FOR THE LAYING AND JOINTING OF 42in. AND 36in. DIAMETER CAST IRON MAINS BETWEEN CRICKLEWOOD AND MARBLE ARCH.
The Metropolitan Water Board invite TENDERS for the LAYING of 42in. and 36in. internal diameter WATER MAINS from the Board's Works at Cricklewood, in the Parish of Willesden, to Seymour-street, in the Parish of St. Marylebone, together with contingent Works.
Drawings, conditions of contract and specification may be inspected without payment of fee at the offices of the Board, Chief Engineer's Department (Room 201), on and after 16th June, 1924.
Form of Tender, conditions of contract and specification, bills of quantities, and schedules of prices, together with drawings and a spare copy of the bills of quantities and schedules of prices, may be obtained on and after 19th June, 1924, from Mr. Henry E. Stilgoe, M. Inst. C.E., the Chief Engineer, on production of an official receipt for the sum of £30, which sum must be deposited with the Accountant to the Board, and will be returned on receipt of a bona fide Tender, accompanied by all the above-named documents and drawings (with the exception of the spare copy of the bills of quantities and schedules of prices, which may be retained by the tenderer). Such payments and applications must be made between the hours of 10 a.m. and 4.30 p.m. (Saturdays, 10 a.m. and 12 noon). Cheques must be made payable to the "Metropolitan Water Board" and not to individuals.
Tenders, enclosed in sealed envelopes, addressed to "The Clerk of the Board, Metropolitan Water Board, New River Head, Clerkenwell, E.C. 1," and endorsed "Tender for Main Laying, Cricklewood to Marble Arch," must be delivered at the offices of the Board (Room 123) not later than 10 a.m. on Monday, 7th July, 1924.
The Board do not bind themselves to accept the lowest or any Tender.
G. F. STRINGER,
Clerk of the Board.
Offices of the Board,
New River Head, Clerkenwell, E.C. 1.
19th June, 1924. 6028

State Electricity Commission OF VICTORIA.
MELBOURNE, VICTORIA, AUSTRALIA.
TENDERS are hereby INVITED for the SUPPLY, DELIVERY, &c., of the following for the Morwell Power Scheme.
Copies of Tender form and specification will be available upon application to
Agent-General for Victoria,
Melbourne-place, Strand,
London, W.C. 2.
SPECIFICATION NO. 24/26.—BUSHING INSULATORS FOR 6600 V. THIFURCATING BOXES.
CHARGE.—£2 2s. for the first three copies of Tender form, conditions of contract and specification complete. This charge will be returned on receipt of a bona fide Tender. A fourth copy and any further copies will be supplied for the sum of 10s. 6d. each. This charge is not returnable.
PRELIMINARY DEPOSIT.—A preliminary deposit of £10 10s. is to be lodged with Tender.
The specifications may be inspected at the above-mentioned office.
The Commission does not bind itself to accept the lowest or any Tender.
Tenders, on prescribed form, properly endorsed and addressed, must be delivered to the undersigned in Melbourne not later than 5 p.m., 15th September, 1924.
R. LIDDELOW,
5956 Secretary.

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PUBLIC NOTICES

The Scottish Gympie Gold MINES, LIMITED.
(IN LIQUIDATION.)

The subscribers have received intimation by cable that the PLANT and MACHINERY at the Mine situated at Gympie, Queensland, will be exposed for SALE by AUCTION on JULY 7th to 11th inclusive. Catalogues of the sale are now available, and parties interested are requested to communicate by cable with their representatives in the Dominion, who will receive copies of the catalogue and all other particulars on application to the Liquidators' Attorney, Colonel D. E. Reid, D.S.O., Gympie, Queensland, or Messrs. Cameron, Sutherland and Seaward, Ltd., Machinery Merchants, Sydney, who have been entrusted with the sale.

C. D. R. WALKER, C.A.,
W. G. DUNLOP, C.A.,
Joint Liquidators.

183, St. Vincent-street, Glasgow.
6th June, 1924. 6410

The South Indian Railway Company, Limited, are prepared to receive TENDERS for the SUPPLY of :—

POINTS AND CROSSINGS.

Specifications and forms of Tender will be available at the Company's Offices, 91, Petty France, Westminster S.W. 1

Tenders, addressed to the Chairman and Directors of the South Indian Railway Company, Limited, marked "Tender for Points and Crossings," must be left with the undersigned not later than Twelve Noon on Friday the 4th July, 1924.

The Directors do not bind themselves to accept the lowest or any Tender.

A charge, which will not be returned, will be made of £1 for each copy of the specification.

Copies of the drawings may be obtained at the offices of the Consulting Engineers to the Company Messrs. Robert White and Partners, 3, Victoria-street, Westminster, S.W. 1.

A. MUIRHEAD,
Managing Director.

91, Petty France, S.W. 1.
17th June, 1924. 6097

In the High Court of Justice (Companies Winding Up).

To be Offered for Sale by TENDER, pursuant to an Order of the Registrar Companies (Winding Up), made in the matter of ALLEN and SIMMONDS (READING), Ltd., Branch Nominee, Ltd., v. Allen and Simmonds (Reading), Ltd., 1923 A. No. 2858, either in ONE LOT as a GOING CONCERN or in the following LOTS :—

LOT 1.

(a) A FREEHOLD GARAGE, SHOWROOMS and OFFICES, situate in the centre of READING, with frontages to Friar-street and Station-road, and containing an area of about 23,000 square feet, together with the ASSETS and the BUSINESS carried on on such premises, and the whole of the SHARE CAPITAL and DEBENTURES in GREAT WESTERN MOTORS, Ltd.

(b) A BLOCK of TEN FREEHOLD COTTAGES adjoining the above.

(c) A FREEHOLD FACTORY at Vastern-road, READING, with Modern Buildings thereon, covering an area of about 14,500 square feet, at present let as a Motor Body Building Works, in connection with the aforesaid business.

LOT 2.

(a) A LEASEHOLD ENGINEERING WORKS at READING, containing a total floor space of about 27,000 square feet, held for an unexpired term of 67 years at ground rents amounting to £77 0s. per annum. These Works are equipped with high-class ENGINEERS' MACHINE TOOLS for the manufacture of Piston Rings and other Specialities of the Company.

(b) THIRTY LEASEHOLD COTTAGES and a RESIDENCE adjoining, held for a similar period at nominal ground rents.

(c) LEASEHOLD PREMISES, suitable for Garages, situate No. 157, Caversham-road, READING, held for an unexpired term of 61 years.

(d) A FREEHOLD PROPERTY on the THAMES at CAVERSHAM, adjoining the Bridge, formerly a Club, but now let off in self-contained Flats.

(e) A FREEHOLD HOUSE, No. 18, King's Meadow-road, READING.

(f) The GOODWILL of the BUSINESS of ALLEN and SIMMONDS (READING), Ltd., as a GOING CONCERN and LETTERS PATENT for "Improvements in the Manufacture of Piston Rings, &c."

LOT 3.

3000 £1 FULLY PAID SHARES, GREAT WESTERN HOTEL (READING), Ltd.

25 £1 FULLY PAID DEFERRED ORDINARY SHARES, and

5500 £1 FULLY PAID PARTICIPATING PREFERRED ORDINARY SHARES in the READING FOUNDRY CO., Ltd.

Tenders, which must be on the form contained in the particulars, are to be sent to the Registrar, Companies (Winding Up), Room 48, Bankruptcy-buildings, Carey-street, W.C. 1, and marked "Tender re Allen and Simmonds (Reading), Ltd.," and delivered under seal by Twelve Noon on or before Saturday, 19th July, 1924.

Particulars, with plan, form of Tender, and conditions of sale, may be had of Messrs. W. B. PEAT and CO., Chartered Accountants, 11, Ironmonger-lane, London, E.C. 2; Messrs. WILDE, WIGSTON and SAPTE, Solicitors, 21, College-hill, London, E.C. 4; and of Messrs. PEACOCK and GODDARD, of 3, South-square, Gray's Inn, London, W.C. 1. 6046

University College, Gower-STREET, W.C.

TENDERS are REQUIRED for CARRYING OUT be EXTENSIONS of the existing HEATING APPARATUS in the South Wing of the College Buildings, according to detailed designs and specifications prepared by me.

Firms desiring to Tender will be requested to deposit in my hands the sum of Five Guineas for copies of the specification, conditions of contract, plans and drawings, of which Four Guineas will be returned on the return of the documents with a bona fide Tender for the work.

The approximate cubical contents of the buildings to be heated is 600,000 cubic feet.

Permission to inspect the premises can be obtained on application to the Secretary of the College.

All applications with remittances must be in my hands by Tuesday morning, July 1st. The Tenders must be sent in by Thursday, July 10th, and the work is to be completed by September 15th.

ARTHUR H. BARKER, B.Sc., A.M.I.C.E., M.Sc.,
Consulting Engineer.
100, Victoria-street, S.W. 1. 6109

Skegness Urban District COUNCIL.
SEWAGE PUMPING STATION.

The Council invite APPLICATIONS for the POSITION of ENGINE DRIVER at the above Pumping Station. Wages £2 10s. per week.

Particulars as to duties, &c., to be obtained from the undersigned.

Canvassing will be a disqualification, and all applications should reach the Council offices not later than July 1st, 1924.

R. H. JENKINS, M. Inst. M. & C.E.,
Engineer and Surveyor.

Council Offices, Skegness.
June 16th, 1924. 6071

SITUATIONS OPEN

WANTED by Important Engineering Firm in Manchester, fully qualified BUYER for all classes of Engineering Materials. Only thoroughly competent men need apply. State age, previous experience, and salary required.—Address, 6063, The Engineer Office. 6063 A

SITUATIONS OPEN (continued)

A LARGE BALL BEARING COMPANY REQUIRE a well-educated COMMERCIAL CORRESPONDENT as an Assistant in their Inquiry Department. Previous experience in Anti-friction Bearings not essential, but applicants should have a sound knowledge of Mechanical Engineering Practice.—Address, 6044, The Engineer Office. 6044 A

AERIAL ROPEWAY ERECTOR.—Thoroughly capable and experienced WORKING ERECTOR REQUIRED for Erection of Aerial Ropeway in Mansfield District. Applicants must state fully previous experience, salary required, &c.—Address, P3228, The Engineer Office. P3228 A

ANGOLA, SOUTH-WEST AFRICA.—REQUIRED, ASSISTANT ENGINEER, age 30 to 35, unmarried, for Railway Construction. Must have had colonial or foreign experience. Knowledge of Portuguese essential.—Write, giving previous experience, to V. Y., c/o J. W. Vickers and Co., Ltd., 5, Nicholas-lane, E.C. 4. 6074 A

ASSISTANT to WORKS MANAGER WANTED, to devote his attention to the maintenance of the works power plant and production on the erecting and assembling side. Must have satisfactory experience in the construction and production of Internal Combustion Engines

Apply, stating experience, salary required, to THE CAMPBELL GAS ENGINE CO., Ltd., Halifax, Yorkshire. 6065 A

BRANCH MANAGER REQUIRED for Liverpool (with engineering experience preferred, qualifications advantageous), with connection amongst shipyards and engineering firms, to represent old-established and well-advertised firm of Rubber Manufacturers specialising for the engineering and allied trades. Salary and liberal commission. Applicants to give full particulars of past experience. First-class references required.—Address, 6082, The Engineer Office. 6082 A

CONTRACTOR'S ASSISTANT REQUIRED for Construction Department of an Electric Supply Undertaking in the Midlands. Must be a good draughtsman, capable of controlling men, supervising work, taking off own quantities and ordering all materials.—Address, stating age, experience, salary required, and when at liberty, 6064, The Engineer Office. 6064 A

ENGINEER, A.M.I. Mech. E., with Established engineers' agency in Victoria-street and influential connection, DESIRES PARTNER (under 35). Small capital sufficient, but must be experienced, capable and energetic.—Address, P3243, The Engineer Office. P3243 A

ENGINEER, Single, Over 35, REQUIRED for Tanganyika Territory, East Africa. Considerable experience of Steam Engines and Boilers of the loco. type, and particularly in the erection of same and of general machinery, absolutely necessary. State salary required, age and experience, and enclose copies only of testimonials, which will not be returned. Three years' agreement, bungalow accommodation, and one servant provided free. Passage paid out and home.—Address, P3211, The Engineer Office. P3211 A

ESTIMATING ENGINEER REQUIRED for Important Firm of Internal Combustion Engineers. Good appearance and manner essential. General all-round engineering experience, electrical and marine particularly desirable.—Address in confidence, 6087, The Engineer Office. 6087 A

FIRM in Midlands Have OPENING for ASSISTANT in Steam Turbine Department. Must be capable of planning complete lay-outs. Applicants should state salary required, experience, and send copies of testimonials.—Address, 6069, The Engineer Office. 6069 A

FOUNDRY SUPERINTENDENT WANTED, South Midlands. First-class experience in all classes of Foundry Practice, including Machine Mouldings. Used to Iron, Steel Alloy and Malleables.—Address, with references, experience, and when available, 6095, The Engineer Office. 6095 A

REINFORCED CONCRETE ENGINEER REQUIRED AT ONCE by London Specialist Firm; previous experience essential; permanency to right man. Give, in confidence, particulars of experience, age, and salary required.—Address, 6101, The Engineer Office. 6101 A

REPRESENTATIVE or AGENT REQUIRED for Sale of Hematite Pig Iron in England and Scotland. Applicants must have thorough knowledge of the trade and be able to influence business.—Apply, stating age, experience, connections and salary or terms required, to THE CARNFORTH HEMATITE IRON CO., Limited, Carnforth. 6090 A

REQUIRED IMMEDIATELY for the Far East, ASSISTANT WORKS MANAGER for Cement Company. Age 35 to 45. Must be well educated and have good personality, with thorough knowledge of Cement Manufacture. Commencing salary about £1000 per annum with quarters. Three years' agreement.—Write in first instance, with full particulars of past experience, to Box 144, Leathwait and Simmons, 34, Tavrogmorton-street, E.C. 2. P3217 A

IMPORTANT
SWISS ENGINEERING WORKS
REQUIRES ENGINEER
FOR
SALES ENGINEERING
ABROAD
(OVERSEAS).

Applicants of Swiss nationality, with a good knowledge of Languages, Technical Education, and thoroughly experienced, should address, giving full particulars of education and experience, with references and copies of testimonials, 6079, The Engineer Office. 6079 A

STEEL CASTINGS.—REPRESENTATIVE REQUIRED for Steel Foundry; capacity 300 tons per month, with available space for extension. Applicant must have influence and connection. Seat on Board may be arranged. State fullest particulars. salary required, in confidence.—Address, 5983, The Engineer Office. 5983 A

CHIEF DRAUGHTSMAN REQUIRED by Firm manufacturing specialities for power stations, collieries, and steel works; must have initiative, good theoretical and practical experience, able to organise. State salary, experience, when at liberty.—Address, 6085, The Engineer Office. 6085 A

DESIGNER DRAUGHTSMAN REQUIRED by London Firm of Reinforced Concrete Specialists; salary £350. State age and experience.—Address, 6072, The Engineer Office. 6072 A

DRAUGHTSMEN.—REQUIRED, SENIOR and JUNIOR DRAUGHTSMEN with experience in High-class Steam Engine Design. Reply in confidence, giving full particulars and salary required.—Address, 6059, The Engineer Office. 6059 A

DRAUGHTSMAN REQUIRED, with First-class experience in the Design of Cement and Ore Crushing Machinery and the Lay-out of Complete Plants.—Apply, stating fully age, experience, and salary, to W. J. C., Edgar Allen and Co., Ltd., Imperial Steel Works, Sheffield. 6058 A

SITUATIONS OPEN (continued)

DRAUGHTSMAN WANTED for North of England, with experience in Locomotive Details.—Address, stating age, experience, and salary required, 6045, The Engineer Office. 6045 A

ENGINE DRAUGHTSMEN WANTED, with Experience in Admiralty Destroyers, for arrangement and detail work.—Reply by letter only, stating age, experience, and salary required, to E. D., c/o Yarrow and Co., Scotstoun, Glasgow. 6047 A

MESSRS. DORMAN, LONG and CO., Ltd., Middlesbrough, REQUIRE ONE or TWO capable DRAUGHTSMEN, thoroughly experienced in designing and detailing Constructional Steel Work for all kinds of Steel-frame Buildings, Bridge Work, &c. Only first-class men need apply.—Letters, stating age, experience, and salary required, to be addressed to MANAGER, Messrs. Dorman, Long and Co., Ltd., Constructional Department, Middlesbrough. 6070 A

PUMPING MACHINERY. — DRAUGHTSMAN WANTED, capable of designing and calculating. State experience, age, and salary required.—Address, 6022, The Engineer Office. 6022 A

REQUIRED for Important Argentine Railway, 2 CARRIAGE and WAGON DRAUGHTSMEN and 2 LOCOMOTIVE DRAUGHTSMEN. Age not more than 30. Salary £400 to £500 per annum; 3 years' contract with option of renewal; free passages out and home provided.—Write, stating particulars of education, training, experience, age, &c., with copies (only) of testimonials, to Box A. B. T., c/o Davies and Co., 95, Bishopsgate, E.C. 2. 6077 A

SHIP DRAUGHTSMAN WANTED, with Experience in Admiralty Destroyers, for arrangement and detail work.—Reply by letter only, stating age, experience, and salary required, to S. D., c/o Yarrow and Co., Scotstoun, Glasgow. 6048 A

SENIOR CONSTRUCTURAL DRAUGHTSMEN REQUIRED, experienced men only. State age, experience, and salary required.—NORTONS (Tividale), Ltd., Tipton, Staffs. 6057 A

STRUCTURAL STEEL WORK DRAUGHTSMAN REQUIRED; experience in rapid and accurate preparation of details of Steel-framed Buildings, especially to L.C.C. requirements. State age, full particulars of qualifications and experience, and salary required.—Address, 6110, The Engineer Office. 6110 A

FOUNDRY FOREMAN WANTED in Works Near London, producing machine and general castings in iron, brass, bronze, and aluminium. Good experience is necessary in all branches of foundry practice, including machine moulding. Applicant must be strict disciplinarian, good organiser, and capable of producing high-class work at competitive prices. State salary read., age, details of experience, and when at liberty.—Address, 6041, The Engineer Office. 6041 A

REQUIRED AT ONCE for West Lancashire District, a FOREMAN BOILERMAKER for the manufacture of the very highest class of Lancashire Boilers. It is essential that the man appointed must have first-class credentials in every respect.—Address, stating age, experience, and salary required, 6051, The Engineer Office. 6051 A

GOOD All-round LIFT ERECTOR WANTED. State experience and wages required.—Address, 6055, The Engineer Office. 6055 A

SITUATIONS WANTED

A.M.I.C.E. (33), Works and D.O. Training, Experience of manufacture and maintenance locomotives, stationary engines and boilers, internal combustion, hydraulic and general engineering, used to control of large staffs, DESIRES POST, works or office.—Address, P3200, The Engineer Office. P3200 B

CHARTERED CIVIL ENGINEER SEEKS ENGAGEMENT as RESIDENT ENGINEER, at home or abroad, or would undertake investigation work. Large experience in sea and harbour work; free now. Highest testimonials from eminent consulting engineers.—Address, 6100, The Engineer Office. 6100 B

CIVIL ENGINEER, Sound Practical Experience in carrying out all classes of building construction, surveying, D.O., &c., also thoroughly experienced in factory management, control of labour and general commercial practice, sound experience of cement manufacturing, SEEKS responsible APPOINTMENT. —Address, P3220, The Engineer Office. P3220 B

ENGINEER, British (35), 16 Years' Commercial, technical and management experience abroad with big firms, first-class connections, fluent French, Italian and German, DESIRES responsible POSITION, preferably with firm dealing abroad.—Box A503, Hutchins and Harris, Advertising Agents, 62, Windsor House, S.W. 1. P3233 B

ENGINEER (23) DESIRES POST to Gain Experience; small salary.—Address, POTTER, 25, Jevington-gardens, Eastbourne, Sussex. 6099 B

ENGINEER, Late Works Superintendent, Previous tool-room manager and designer, WANTS CHANGE as ASSIST. or WORKS MANAGER. Experienced on automobile, general and tool work, good organiser; can get results.—Address, P3223, The Engineer Office. P3223 B

ENGINEER REPRESENTATIVE. — ENGINEER DESIRES APPOINTMENT as Resident Agent in London for provincial concern. All-round experience, commercial, technical, practical, draughtsman. —Address, P3234, The Engineer Office P3234 B

ENGINEER (37) REQUIRES APPOINTMENT, mechanical, electrical, administrative, technical, construction, sales. Experienced lay-out works, estimating, purchase, sales, contracts, manufacture, testing, erection, control technical staffs, D.O. and workmen.—Address, P3227, The Engineer Office. P3227 B

ENGINEER (40), Wide Experience with Leading firms, 14 years works manager and assistant, D.O. and commercial experience, machine tools, I.C. engines, foundry, millwrighting, modern production methods good organiser, DESIRES POSITION.—Address, P3235, The Engineer Office. P3235 B

METALLURGIST, Experienced, REQUIRES APPOINTMENT; capable of taking entire control of foundry, iron, steel, non-ferrous, or heat treatment departments.—Address, P3219, The Engineer Office. P3219 B

REPETITION WORK.—ADVERTISER (25) SEEKS responsible POSITION; 10 years' experience, up-to-date knowledge of machines, press, and machine tools, jigs, &c.; good draughtsman with theoretical knowledge.—Address, F. GEUBBERT, Stonemarsh Villa, Barton-on-Humber. P3216 B

WORKS MANAGER, A.M.I. Mech. E. (40), DESIRES CHANGE; 24 years present, 10 years previous post. Exceptional experience management and organisation, jig design, costing, rate fixing. Precision repetition work. Expert stainless heat treatment and finish. Smart, tactful, keen disciplinarian. Used to all classes of labour.—Address, P3212, The Engineer Office. P3212 B

YOUNG CIVIL ENGINEER (22) Technical and university training, shop and D.O. experience, REQUIRES POST; railway constructional, &c. London district.—Address, P3210, The Engineer Office. P3210 B

YOUNG ENGINEER (21), Taking B.Sc. Eng. (Lond.) final next month, WISHES to GAIN EXPERIENCE, civil eng. preferred; has had 4 years' practical experience of mech. eng., including 6 months D.O. and commercial departments, 2 years' college training; prepared to go abroad; fluent French.—Address, P3221, The Engineer Office. P3221 B

DRAUGHTSMAN, Experienced in Steel Works, colliery and heating and ventilating plant, DESIRES CHANGE; would like to specialise; go anywhere. I.C.S. student, A1 refs.—Address, P3235, The Engineer Office. P3235 B

SITUATIONS WANTED (continued)

DRAUGHTSMAN SEEKS ENGAGEMENT; 6 Years' shops, 3 years drawing-office, all phases of general engineering.—H. W. OSBORNE, 27, Bath-road, Dartford. P3231 B

ENGINEER DRAUGHTSMAN, Age 49, 25 Years' experience, including agricultural designing, works management and production; chief draughtsman in drawing-office for munitions, &c., for 7 years, thoroughly competent all branches, SEEKS ENGAGEMENT, any capacity, with view of advancement. Undeniable references.—Apply, FELGATE, c/o Ellis ton, 61, Gt. Portland-street, W. 1. 6105 B

EXPERIENCED ALL-ROUND MECHANICAL DRAUGHTSMAN SEEKS SITUATION in or near London, either in the capacity of draughtsman or any other in which he may be useful. Good references. —Address, P3241, The Engineer Office. P3241 B

JUNIOR DRAUGHTSMAN or TECH. ASSISTANT (23), A.M.I.E., 5 yrs. public school, 5 yrs. workshop, 5 yrs. technical education, National Engineering Certificate and others, electrical work. Conscientious; low salary; London district.—Address, P3237, The Engineer Office. P3237 B

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MECHANICAL ENGINEER, A.M.I. Mech. E., M.I.E.I. (34), experience dockyard plant, all descriptions construction and maintenance, marine, including turbine and heavy-oil, turbo-electrical power station and auxiliary plant. Last 8½ years chargehighest-class inspection, technical and supervisory, national and private factories, including testing materials. Last three years purchase and inspection precision tools, equipment; used visiting, knows North. SEEKS PARTNERSHIP, consulting or inspecting engineer. Moderate capital.—Address, P3240, The Engineer Office. P3240 C

WELL-ESTABLISHED ENGINEERING CONCERN OPEN to RECEIVE well-educated YOUTH. Principals are without successors. Capital necessary, but not of immediate concern.—Address, P3206, The Engineer Office. P3206 C

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A YOUNG ENGINEER, Works and D.O. Experience, WISHES to REPRESENT FIRM of ENGINEERS, MANUFACTURERS. Large London connection, City office, telephone.—Address, P3224, The Engineer Office. P3224 D

AGENCY WANTED.—Provincial Firms, Note!— ENGINEERS' AGENTS.—Principal, A.M.I. Mech. E., with offices in London, Antwerp and Stockholm, are OPEN to REPRESENT (at first in London) a MANUFACTURER of good standing. Considerable time and effort will be devoted to enterprising firm.— —Address, P3242, The Engineer Office. P3242 D

ENGINEER, Live Man, with London Office, is PREPARED to ACT as REPRESENTATIVE to Engineering Firm. Interview solicited.—Address, P3215, The Engineer Office. P3215 D

ENGINEER, M.I. Mech. E., Highly Trained, WISHES to HEAR from FIRMS of good standing needing REPRESENTATION in the Midlands. Advertiser experienced in steam, electrical, and mining plant, steam and other road vehicles, centrifugal fans and pumps, also long commercial experience.—Address, P3225, The Engineer Office. P3225 D

ENGINEER, with Central Office and Car, Middlesbrough, DESIRES good AGENCY or DIRECT REPRESENTATION, reputable firm; would consider whole-time representation.—Address, P3239, The Engineer Office. P3239 D

MECHANICAL ENGINEER, M.I. Mech. E., with wide and varied technical and commercial experience, perfect knowledge of Russian and German, fair French, is DESIROUS to ACT as LONDON REPRESENTATIVE of a first-class British Firm wishing business with RUSSIA and BALTIC STATES. Good references and connections. No salary, only commission and part office expenses.—Address, P3230, The Engineer Office. P3230 D

MISCELLANEOUS

FRENCH FIRM of CONSTRUCTIONAL ENGINEERS, possessing the most modern methods of production, DESIRES to come to an ARRANGEMENT with a British Firm for the MANUFACTURE in France of good selling patented MACHINES and TOOLS.—Kindly send replies to P3232, The Engineer Office. P3232 I

STORAGE DEPOSITORY for Machinery, Plant and Merchandise.—For terms apply, STORES DEPT., Plant House, W. 5. 5954 I

For continuation of Small Advertisements see page 3.

See Illustrated Advertisement last week and next.
SMITH'S RELIABLE CRANES
Thomas Smith & Sons (Rodley) Ltd., Nr. Leeds.

A Seven-Day Journal

Launch of H.M.S. Adventure.

ON Wednesday, H.M.S. Adventure was launched at Devonport Dockyard. The naming ceremony was performed by Lady Chelmsford, wife of the First Lord of the Admiralty. This vessel, a cruiser-minelayer, was the first man-of-war of any considerable dimensions to be laid down for the British Navy subsequent to the conclusion of peace. Her keel was laid on November 29th, 1922, so that she has been on the slip rather more than eighteen months. Like all the British warships built during and immediately after the war, the Adventure was designed by Sir E. T. d'Eyncourt. She is the first minelayer to be built as such for the Royal Navy, all the other vessels of this class having been converted to their present duty. While official details are still withheld, a service paper states that the displacement will be about 7000 tons. A sum of £404,347 had been spent on the ship up to the end of the last financial year, while a further £323,236 is to be disbursed under the current Navy Estimates. Of this sum, £112,000 goes for labour and £98,400 for contract work. With the Adventure afloat, preparations are being made for laying down on the same slip the new light cruiser Cornwall, one of the five new cruisers authorised this year as part of the Admiralty's replacement programme. With the launch of the Adventure, there is now only one vessel of war actually under construction in this country—the submarine O 1, recently laid down at Chatham. This state of affairs, we believe, is without precedent in the modern history of the British Navy. Orders for the two torpedo-boat destroyers for which provision is made in the current year's Navy Estimates have now been placed with John I. Thornycroft and Co., Limited, Southampton, and Yarrow and Co. (1922), Limited, of Scotstoun, Glasgow. The total expenditure on these new vessels during the current financial year is £147,848.

American Naval Disaster.

WHILE the United States battleship Mississippi, with other units of the Pacific Fleet, was engaged in firing practice near San Pedro on June 12th, an explosion occurred in No. 2 turret, causing the death of three officers and 35 men. Early reports of the disaster attributed it to a short circuit in the electrical firing apparatus, but this explanation was not accepted by those familiar with gunnery matters. It seemed much more probable that the air blast had failed to operate properly, with the result that smouldering fragments of the previous charge, left in the powder chamber, ignited the next cartridge as it was being rammed home; or, alternatively, that a flare-back had occurred when the breech was opened, producing the same effect. Colour is lent to the first named theory by the evidence of one of the three survivors of the turret crew, a seaman, who states that the air blast had become defective early in the firing. According to the same witness, the air pressure was so low that it was necessary to move the breech-block—which is also operated by compressed air—by manual power. Should this evidence be corroborated, one need not seek further for the cause of the disaster. The explosion, though deadly in its effect on the crew of the turret, was not so violent as to cause serious damage either to the turret or the ship, and it is estimated that all repairs can be completed within a fortnight. The Mississippi carries twelve 14in. 50-calibre guns, mounted in triple turrets. Shortly after the first explosion another gun in the same turret was discharged, probably by the heat, and the 1400 lb. projectile narrowly missed a passenger steamer.

The Largest Australian Ship.

THE steamship Fordsdale bears the distinction of being the largest ship yet built and engined in Australia. She belongs to the Australian Commonwealth Line, and after visiting Liverpool and Glasgow on her maiden voyage, she sailed from the Clyde last week for Australian ports. The Fordsdale was built at the Commonwealth Dockyard, Cockatoo Island, Sydney, New South Wales. Her principal dimensions are as follows:—Length, 520ft.; extreme breadth, 63ft. 3in.; depth to shelter deck, 44ft. On a draught of 29ft. 10in. she has a deadweight capacity of about 12,700 tons. Her cargo is carried in six roomy holds with hatches 24ft. wide, which vary in length between 21ft. 6in. and 28ft. 6in. The derrick equipment is of modern design, and the hatches are served by 27 steam winches. Out of a total cargo capacity of 757,000 cubic feet 158,300 cubic feet are reserved for refrigerated cargo. The refrigerating machinery is of the CO_2 type, and was made by the Liverpool Refrigerator Company, Limited. The twin quadruple expansion reciprocating steam engines propelling the ship were built at the Commonwealth Dockyard, and the cylinders of these engines are 23½in., 34in., 48½in. and 70in. diameter respectively, with a stroke of 54in. Steam is raised in six single-ended Scotch boilers, fitted for burning either oil or coal on the Howden-Wallsend system. An interesting feature of the vessel's electrical equipment is the use of a new type of automatic ship's telephone invented by Mr. H. E. Bingham, of Sydney, and termed the Binghamphone. It is fitted at all control stations, and it is claimed that by its use conversation can be conducted without interference from machinery or other noises. The Fordsdale, although a cargo ship, completed the passage from Fremantle to London *viâ* the Suez Canal in 29 days and 14 hours, which is a remarkably good performance. Last week the Ferndale, a sister ship to the Fordsdale, was launched from the Cockatoo Dockyard, at Sydney, and it is hoped that this vessel will take up her service between Australia and the United Kingdom early in 1925.

French Canal Works.

THE extensive works which are being carried out on the Orleans Canal form part of a vast scheme which is to put Brittany, the Maine and Anjou into communication with Paris and the northern and eastern departments of France. The execution of this scheme is being undertaken by an association of all the Chambers of Commerce in the Loire Basin, with the aim of providing cheap water transport for one of the largest and most fertile agricultural regions in France. It is intended to create a lateral maritime artery in the same way as the Rhone will be made to serve as a communication between Central Europe and Marseilles. The Loire, however, is so shallow that it will have to be entirely canalised between Orleans and Angers. A preliminary scheme for the construction of the first section, 130 kiloms. long, has been approved of by the Association of Chambers of Commerce. It will necessitate the construction of 105 bridges and 11 locks.

The Southern Railway Electrification.

VERY good progress is being made with the work of electrifying the suburban portions of the South-Eastern section of the Southern Railway. Continuous employment is now being given to about 1300 men, and contracts to a total value of 1¾ million sterling have already been placed. Bonding of the track has been completed over 56 miles, and 86 miles of high-tension cable are in process of being laid. Steel work for four of the sub-power stations is being erected, and the foundations for ten others are being laid. The construction of the rolling stock and its electrical equipment is proceeding satisfactorily.

A New Liner Service.

RECOGNISING the increasing importance of traffic between Scotland, Northern Ireland and the United States, the Royal Mail Steam Packet Company has decided to institute a new liner service between New York, Plymouth, Belfast and Greenock. The 15,000-ton 15-knot steamer Orduna, built by Harland and Wolff at Belfast in 1914, has been set aside for this work, and she will, we learn, be based at Greenock. On her westbound voyage the liner will call at Belfast and, returning from New York, she will call at Plymouth, Belfast and Greenock. The Orduna was accorded a civic welcome on her arrival at Plymouth last week. It is hoped that the new service will prove so successful that it may be necessary to continue it during the winter months.

An Indian Bridge Scheme.

NEWS from Calcutta has been received to the effect that the Bengal Government has published the terms of a draft Bill in connection with the proposal to erect a cantilever bridge across the river Hooghly, between Howrah and Calcutta. The scheme proposed in the Bill is estimated to involve an expenditure of four million pounds. It is intended to recover the cost by taxation and by levies imposed on the users of the bridge. The existing bridge, it is reported, has been declared by experts to be in danger of collapse, but in spite of this fact, local opposition to the new scheme may be forthcoming to an extent that will make its execution impossible.

The Tube Railway Strike.

To their great relief Londoners found, on Friday morning last, that the trains on the tubes were again running almost under normal conditions, and that most of the stations were open. The firm attitude of the Underground authorities and the plain words of Mr. Cramp to the strikers, in which he characterised them as being false to their own cause, made the prospect of the strike spreading very remote. The final blow was, however, administered when the power-house men's union decided on Thursday night that its men should not be called out. The men on the Underground and those on the Great Western, as a consequence, reported for duty on Friday morning. In railway circles the opinion prevails that the defeat of the men will not be without influence on the enginemen. Particularly is this result likely to follow now that the National Union of Railwaymen is again affirming its disapproval of any repudiation of the award of the National Wages Board. The fact of the matter is that the Associated Society is jealous of what the National Union has done, and evidently is resolved to show how very much more it can do for its members. To the credit of the National Union be it said that it has never gone back on its word. For the men it has now secured many concessions, and the companies find it a convenience to have a body like it to deal with. It is not likely to spoil the good impression made.

Extending the Airways.

IN fulfilment of its obligation to extend the sphere of operations of the air services which it took over, Imperial Airways on Tuesday opened a new air connection between London and Switzerland. The journey commences at Croydon at 10.15 a.m. At 12.45 p.m. the Paris station at Le Bourget is reached, and after an interval for lunch the passengers resume their journey at 2.15 p.m. by a flight to Basle, which is reached at 5.30 p.m. An interval for tea is allowed, and thereafter the flight is resumed to its terminus at Zurich, the time of arrival being 6.45 p.m. It is hoped shortly to open an extension of this route, which will take the passengers on to Rome. It is obvious that without considerable development in night flying, the service thus planned must be confined to the summer.

The Brennan Helicopter.

CERTAIN statements published regarding the Brennan helicopter, which has been under construction for the past five or six years at the Royal Aircraft Establishment, Farnborough, seem to be a little wide of the mark and misleading. It can hardly be accurate, for instance, to say that the machine has now reached such an advanced stage of development that it has been handed over by Mr. Brennan to the Air Ministry, for it has been constructed under the Ministry's auspices and at the Government's expense. It will be recalled in this connection that its official ownership has been recognised by the fact that it has been expressly excluded from taking part in the helicopter competition for which the Air Ministry is now offering prizes totalling £50,000. As regards reports to the effect that the machine in the course of preliminary trials has given much promise of success, we understand that the truth is that so far it has not executed any free flight either in the vertical or horizontal direction.

Steam versus Electricity.

IN his presidential address at the annual meeting of the Association of Mining Electrical Engineers, Mr. George Raw said that at collieries steam power was still necessary. Whilst complete electrification was the ideal scheme from a purely engineering point of view, he questioned whether mining engineering practice had reached such a stage that the modern colliery could advantageously dispense with its steam plant. Just as modern communities found that they needed both gas and electricity, so modern colliery practice probably demanded both steam and electrical motive power. Referring to the super-power station craze, which arose at the close of the war, Mr. Raw remarked that a cheap and extended supply of electricity would be brought about by British inventiveness and hard work, rather than by political schemes. The super-power station idea expired during the slump period. The trade depression following 1921 had been a salutary experience, producing a measure of economical and industrial sanity after the delirium of the two preceding years.

Uniform Lighting System for Estuaries.

AT the International Navigation Congress held in London in July last year, Mr. A. E. Butterfield, engineer to the Humber Conservancy Board, presented a paper describing a uniform system of lighting estuaries and tidal rivers. The necessity for such uniformity was strongly urged on that occasion by many members of the Congress, who were responsible for the lighting and marking of rivers and estuaries. It is of interest to learn that Mr. Butterfield's Board has decided, with the approval of the Corporation of Trinity House, London, to adopt his scheme for the Humber. The system is to be brought into force on August 8th, and it is anticipated that no difficulty will be experienced in effecting the change involved in the twenty-two lights in the interval between sunrise and sunset of one day. Up to now, in the Humber, lights of various colours have been used to mark particular shoals, but the system to be adopted provides that all the lights on the port side on entering from the sea shall be of red colour, and all on the starboard side shall be white. These lights will be of the character known as single flashing. In addition, where local channels diverge from the main channel, the turning point will be marked by a double-flashing light of the same colour as the other lights on that side of the channel from which the divergent channel runs. What are known as "middle" grounds—sands round which it is safe to navigate on either side—will be marked by buoys showing a triple flash, and this light will be either red or white, depending upon which side of the sand the deeper or more easily navigated channel exists. In all cases the mariner, on entering the river from the sea, will keep the white flashing lights on his starboard side and the red flashing lights on his port side.

The British Empire Exhibition.

ENGINEERING EXHIBITS, No. IX.*

GENERAL ENGINEERING EXHIBITS.

THE MIRRLEES WATSON COMPANY, LIMITED.

THE varied exhibits on the stand of the Mirrlees Watson Company, Limited, of Scotland-street, Glasgow, are fully representative of all branches of the firm's activities, and include sugar machinery, water distilling plant, multiple effect evaporators for industrial purposes, vegetable oil extraction plant, condensing plant and centrifugal pumps.

Sugar Machinery.—The heavy character of the machinery which is employed in the production of cane sugar precludes any extensive display, either of cane-crushing mills or of juice-evaporating plant. The company has therefore wisely chosen to represent the former class of machinery by a single three-roller cane-crushing mill and the other machinery by a series of well arranged models which have been constructed so that the internal construction of the plant may be clearly seen. The crushing mill which is shown has three 24in. diameter rollers, each 48in. long. Hydraulic pressure regulators are fitted to the top roller. In actual service the mill would form part of a train of three or four similar mills, preceded by a special type of crusher for preparing the cane for milling. The mills in general use in sugar factories range from small single mills of the type shown, with three rollers 18in. in diameter and 24in. long, having a crushing capacity of about 2 tons of canes per hour, up to trains of mills comprising two preparatory crushers and seven mills with rollers 36in. dia. by 84in. long, which are designed to crush from 130 up to 150 tons of canes per hour. Such mills are gear driven, and are operated either by reciprocating steam engines, electric motors or water turbines. An excellently arranged series of photographs on the stand shows examples of large mills and various factory equipments which have been supplied by the company.

Reality is added to the mill exhibit by a group of sugar canes which have been specially brought from the West Indies. Cane refuse is also shown leaving the mill, and exhibits the state of the crushed cane after it has passed through a train of mills. Such refuse is known in practice as begasse or megass, and is used for generating the necessary steam required in the process. In well-designed factories the greatest possible attention is paid to the composition of the megass, and to the efficient utilisation of the steam raised by its combustion in specially designed boilers. As far as possible an

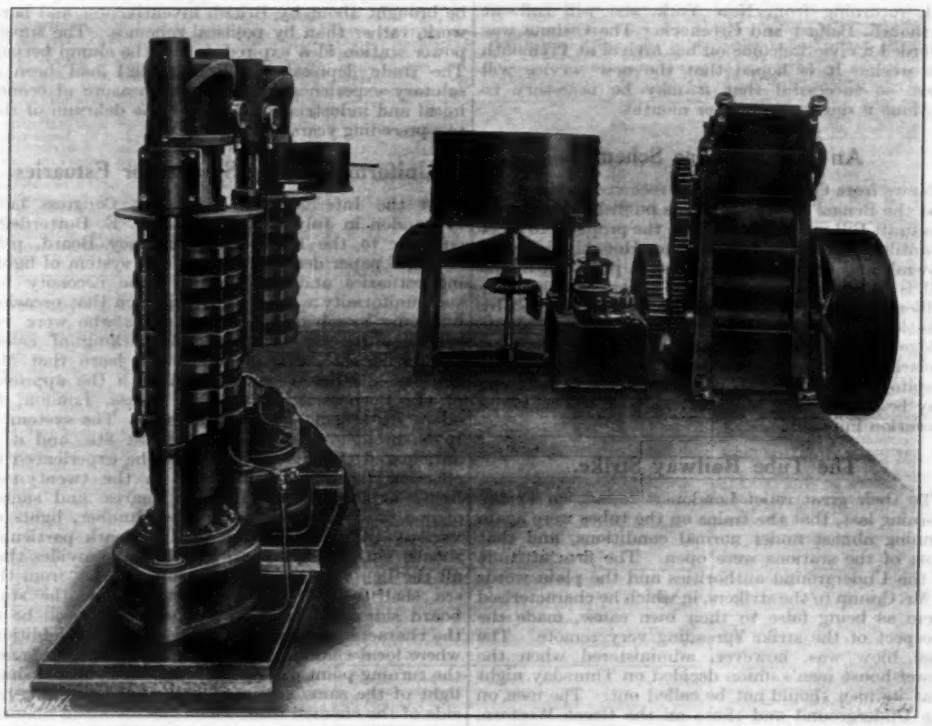


FIG. 183—OIL EXPRESSING PLANT—MIRRLEES WATSON

endeavour is made to carry on the process with the heat resulting from the combustion of the megass, without the aid of any other fuel. This being essential for the economical working of the plant.

The process of evaporating the juice which results from the crushing of the cane is illustrated by a model of a multi-effect evaporator working in conjunction with a barometric jet condenser. The model is made partly in section and partly with a glass body, so that the small brass tubes through which the juice

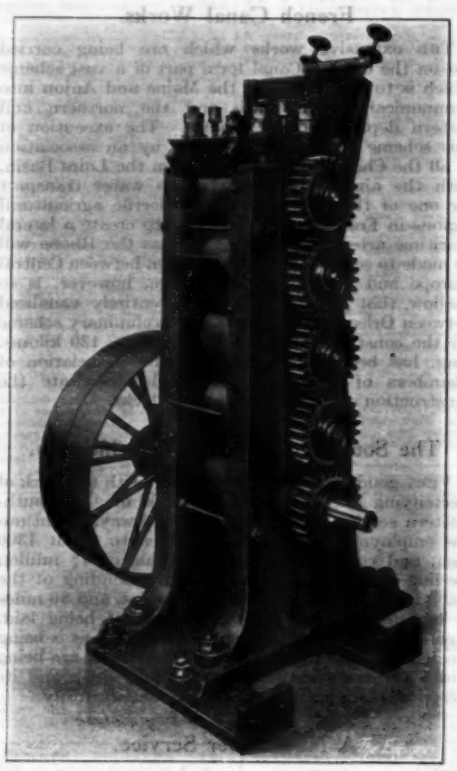


FIG. 184—SEED ROLLS—MIRRLEES WATSON

passes during its concentration are seen, as well as the large circulating tube, which maintains a rapid and constant flow of juice through the smaller tubes. Such evaporators are made to work either by triple or quadruple effect, and in practice they may be of sizes ranging from 3ft. up to 14ft. in diameter.

The exhaust steam from the mill engines is generally used for evaporating the juice, and it enters the first calandria or heating body at a pressure of from 5 lb. to 8 lb. per square inch, while the vapour space of the last calandria is connected to the condenser, which maintains a vacuum of 26in. to 27in. With such an arrangement, the steam or vapour in the different heating bodies between the first and last calandria is at intermediate temperatures and pressures, and the vapour given off from the first vessel passes to the heating body of the second vessel and causes a portion of the liquor in that vessel to be evaporated. In this way 1 lb. of exhaust steam supplied to a triple-effect evaporator will in theory evaporate nearly 3 lb. of water, or 4 lb. of water in the case of a quadruple-effect evaporator. The loss by radiation reduces these figures in practice by about 10 per cent., so that evaporating plant of this type usually works at an efficiency of about 90 per cent. The model clearly indicates the sight glasses for observing the interior of the vessels on the boiling side; the vacuum and pressure gauge connections, and the arrangement of the piping for the removal of the incondensable gases and the drain water.

Vacuum pans are used for the further concentration of the syrup received from the evaporators, and methods of working are adopted which encourage the formation of large crystals. Two models of such pans are shown, one with a number of tubular copper heating coils and the other with tubes about 4in. in diameter expanded into tube plates. These models have also been made partly in glass, so that the internal construction is shown, and the method of working may be easily demonstrated.

Distilling Plant.—This company has for many years paid considerable attention to the problem of the distillation of fresh water, and it has constructed a large number of notable water distilling plants. At almost every port between Port Said and Aden there is an entire absence of fresh water, and the only means by which it can be supplied is by distillation from sea water. The Mirrlees Watson Company's Sextuple effect evaporators are now in use, we learn, at every one of these ports, and are producing, according to the size of the plant, from 20 up to 350 tons per day of fresh drinking water. A model of this type of distilling plant is shown.

The ice factory at Port Said, the railways at Suakim, the pilgrims bound for the Holy cities, the merchants of Eritrea, and ships calling at Perim and Aden are all dependent for their fresh water supplies on such a distilling plant. In the same way, the cities and railways of the arid coast of Chile use similar plants, while the railways of Andalusia, Western Australia, Africa and many other places have adopted such apparatus to ensure a satisfactory supply of loco-

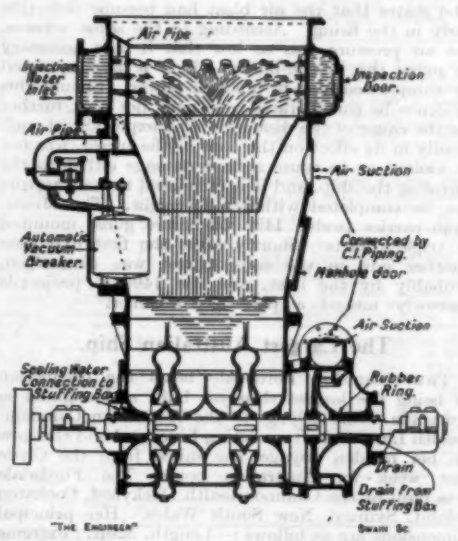


FIG. 185—JET CONDENSER—MIRRLEES WATSON

motive feed water. During the war the Mirrlees Watson Company supplied a 250-ton distilling plant for erection on the Island of Mudros, which plant was used to provide drinking water for the troops in Gallipoli and the East and for hospital service.

With evaporators of the type shown, we learn that from 36 lb. to 40 lb. of drinking water are readily obtained from the combustion of 1 lb. of fuel, and that, in addition to the drinking water produced, the boiler is also fed with freshly distilled water. Such evaporators can be constructed to work with coal, oil or other fuel as desired.

Oil Mill Plant.—The company also shows a small oil-expressing plant, but makes it clear that the construction is similar to that of larger plants, the

* No. VIII. appeared June 13th.

manufacture of which is now undertaken. A complete plant of the type exhibited is shown in Fig. 183. In the actual exhibit, however, the meal kettle and the pumps are omitted, there is but one press, and the whole is on a smaller scale, as may be judged from the illustration of the crushing rolls given in Fig. 184.

The crushing rolls are of the familiar Anglo-American type, with five superimposed rolls giving four crushings of gradually increasing intensity. The feed hopper at the top contains a revolving feed roll and a regulating slide. Steel scraper plates placed against the alternate sides of the rolls guide the seed from side to side through the rolls as it falls from the

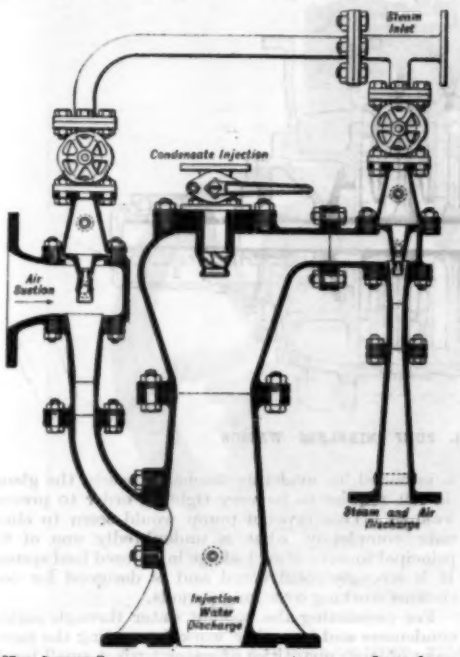


FIG. 186—MIRRLEES JET-INTERCOOLER EJECTOR

hopper on to the base plate. The pressure is applied to the train of rolls through springs acting against the uppermost one. From the rolls the crushed seed passes to a steam-heated kettle provided with an agitator, and a steam spray for moistening the meal. The hot material is then transferred direct to the hydraulic press, for as this press is of the cage type, no intermediate meal-moulding machine is necessary. The cage type of press is generally held to be particularly suitable for dealing with seeds and nuts containing a high percentage of oil. It is also commonly agreed that the fact that the meal does not need to be confined in bagging results in a considerable economy of labour and material. The cage in the Mirrlees press is, as is customary, built up of vertical steel bars, hooped with steel rings. The bars are recessed to a squat tee section, so that when assembled they leave between each pair a narrow slit on the inside and a wider slit on the outside. The narrow slit permits the oil to flow from the meal to the outside of the cage, but holds up the meal itself. The cage is free to float on its guiding columns through a restricted range, in order that the cakes may be pressed equally from the top to the bottom of the pile. The expressed oil collects in a rectangular tray at the foot of the press. When the pressing has been completed, the hydraulic pressure is released, the cage falls to the extent of the floating freedom allowed it, and the swinging head attached above it on one of the columns is moved to one side. Re-application of the hydraulic pressure now results in the cage rising a few inches until it is brought up against collars on the columns. The ram being allowed slowly to rise still further, causes the cakes to be ejected from the top of the cage.

The press exhibited has a capacity of about 1½ cwt. of seed an hour, and the complete plant, including press, kettle, rolls, pumps and other details, weighs some 5 tons. The same type of plant is made in various sizes up to a capacity of about 6 cwt. an hour.

Condensing Plant.—In this section the firm is showing a full-sized jet condenser complete with rotary air and water extraction pumps, in addition to which two different types of steam jet air ejectors and several centrifugal pumps are exhibited. One of the most prominent features of the exhibit is the jet-condensing plant which represents the most recent advance in multi-jet condenser design. It is so arranged that the internal parts of the condenser and the vacuum breaker can be seen, and the pump covers have been removed and parts cut away so that the air pump blade wheel and the impeller of the extraction pump can be inspected.

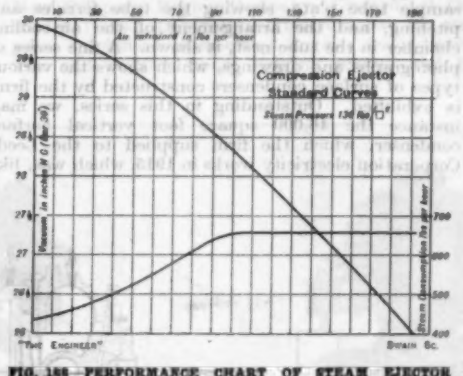


FIG. 188—PERFORMANCE CHART OF STEAM EJECTOR

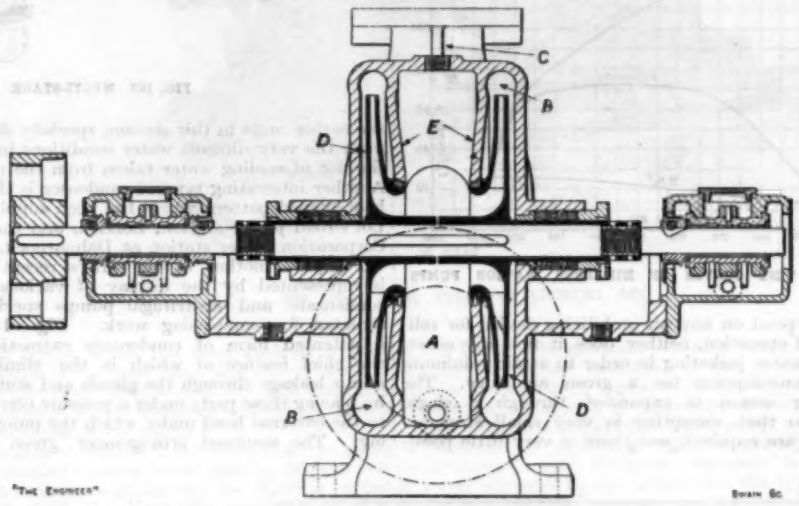


FIG. 189—CONDENSATE EXTRACTION PUMP—MIRRLEES WATSON

The drawing reproduced in Fig. 185 will serve to indicate the chief features of this plant, while a general view of a similar condenser is shown in Fig. 191. The height of the condenser is very moderate, so that it can be placed below the steam turbine without undue depth of basement. Around the top part of the condenser a water belt is formed, into which the injection water passes. The water enters the steam space through a series of simple slots formed in the belt, and is broken up into a large number of jets, which converge and fall into the contracting cone or nozzle, through which the mixture of condensed steam and condensing water passes into the main body of the condenser. This cone forms a special feature of the design, since the effect of the falling water brings about an appreciable compression of the air and incondensable gases, which reduces the capacity of the air pump required. The method of spraying and mixing in the compression cone further results in a very small difference in temperature between the entering steam and the discharge water, which, we are informed, is only 2 deg. to 4 deg. Fah., depending on the amount of air present in the condenser.

The water extracting pump is arranged to form an integral part of the condenser, and attached to it is the air pump of the familiar Mirrlees-Leblanc rotary type. Reference may be made to the automatic vacuum breaker fitting, which is neatly housed to one side of the casing, so that the float and working parts are protected. Its purpose is to admit air to the condenser and to prevent it becoming flooded if for any reason the water extractor pump should fail. This part of the apparatus is very substantially constructed and facilities for its inspection are provided. It will be noted from Fig. 185 that the air is admitted by the vacuum breaker to the condenser at a point above the water injection inlet. This makes the breaker extremely quick in its action, thereby adding to the safety of the plant.

Although the condenser exhibited is provided with a rotary air pump, steam jet ejectors are often supplied with this class of plant, and the illustration reproduced in Fig. 191 shows a condenser so fitted. This also shows the vacuum breaker fitting and the protected type of gauge glass which is used.

Amongst the comparatively recent developments in power station equipment, the most striking is the increasing use of the steam jet air ejector. The Mirrlees Watson Company was a pioneer in the introduction and development of this type of apparatus, which, although very simple in principle, requires very careful attention to design if high vacuum, together with large air capacity and minimum steam consumption, are to be obtained. Initial difficulties with this type of air extractor have only been surmounted after many years of actual working experience, and much careful experimental work.

Two of the latest patterns of steam jet air ejectors are exhibited, each of the two-stage type with an intercooler. Both types are designed for vacua of within 1in. of the barometer. The direct jet intercooler type of ejector is illustrated by Fig. 186, which shows this simple and compact type of air ejector. Fig. 187 shows the other form of ejector with an intercooler of the tubular or surface type. The sections reproduced in the illustration referred to, show that there are two steam compartments in the intercooler, one of which is used for condensing the steam from the first stage ejector, and the other that from the second stage ejector. Alternatively, a single compartment intercooler may be employed with an inde-

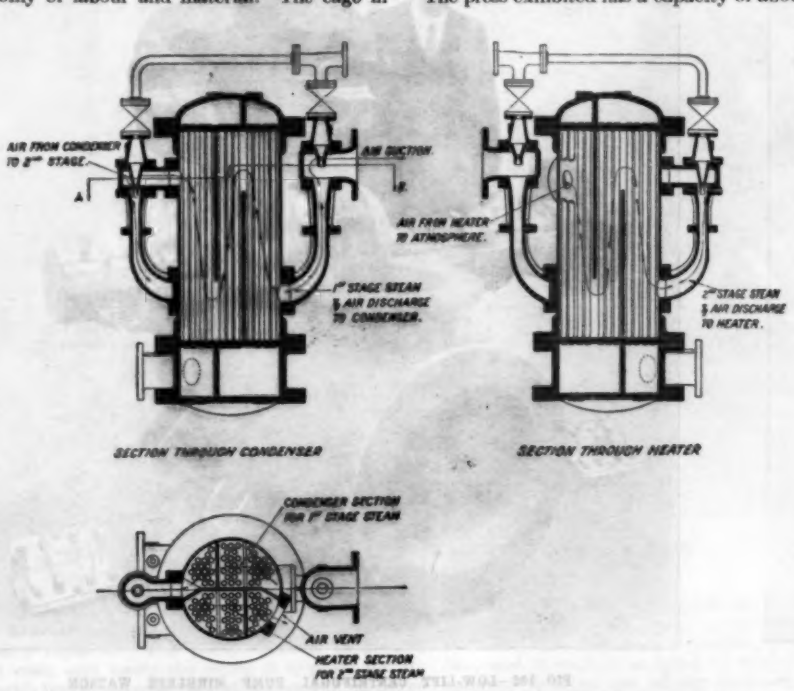

AIR FROM CONDENSER TO 2ND STAGE.
AIR SUCTION
A
B
AIR FROM HEATER TO ATMOSPHERE.
1ST STAGE STEAM & AIR DISCHARGE TO CONDENSER.
2ND STAGE STEAM & AIR DISCHARGE TO HEATER.
SECTION THROUGH CONDENSER
SECTION THROUGH HEATER
CONDENSER SECTION FOR 1ST STAGE STEAM
AIR VENT
HEATER SECTION FOR 2ND STAGE STEAM

FIG. 187—STEAM EJECTOR WITH SURFACE INTERCOOLER—MIRRLEES WATSON

pendent condenser heater for the second stage steam.

As regards the amount of air extracted and steam consumed, the results are, we learn, the same for both types, but the tubular type of intercooler has certain advantages, especially in connection with a closed feed system, as the condensate circulated through the intercooler tubes does not come into contact with the air extracted from the condenser.

The Mirrlees Watson Company does not, we understand, depend on any air stabilising device for reliability of operation, neither does it find any necessity for water jacketing in order to attain minimum steam consumption for a given air duty. The operating steam is expanded through a single nozzle, so that, excepting in very small sizes, no strainers are required, and there is very little possibility of choking occurring. We noted that a steam ejector of the surface intercooler type, along with a condensate pump, is installed on the geared steam turbine condensing locomotive shown by the North British Locomotive Company, Limited, of Glasgow, and described in our issue of April 25th. The curves reproduced in Fig. 188 form a typical performance chart for a Mirrlees steam jet ejector. On the upper curve the weight of air is dealt with, and different vacua are given, and the lower curve shows the steam used.

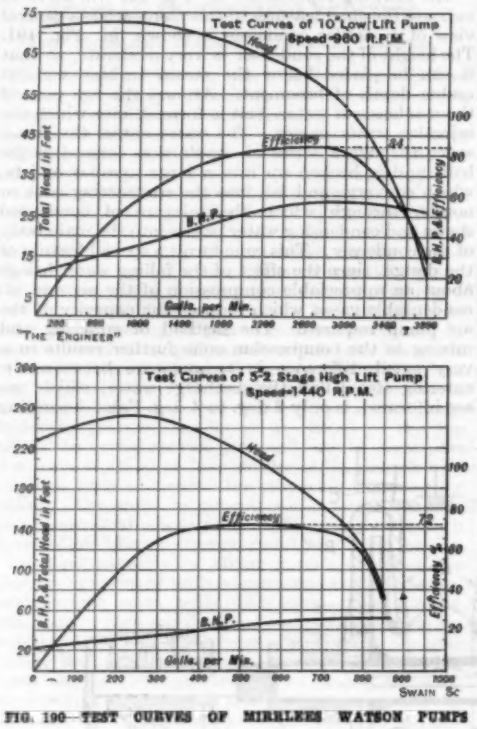


FIG. 190—TEST CURVES OF MIRRLEES WATSON PUMPS

For many years past the Mirrlees Watson Company has specialised in the design of surface condensers. This type of plant is too large to be exhibited, but a sample tube plate, showing the tube ferrules and pitching, and the arrangement of the air-cooling chamber in the tube nest, is shown. A fine series of photographs and drawings, which shows the various types of surface condensers constructed by the firm, is exhibited. Outstanding in this series, we may instance the 46,000 square foot vertical surface condenser, which the firm supplied to the Leeds Corporation electricity works in 1915, which was, like the earlier units in this station, specially designed to meet the very difficult water conditions imposed by the use of cooling water taken from the river Aire. Another interesting type of condenser is the shallow boat-shaped pattern which has been supplied to the Lot's-road power station, London, and the Glasgow Corporation power station at Dalmarnock, Glasgow.

Pumps.—Another of the firm's recent activities is represented by the display of various types of condensate and centrifugal pumps specially constructed for condensing work. Fig. 189 shows a patented form of condensate extraction pump, the chief feature of which is the elimination of all air leakage through the glands and stuffing-boxes by placing these parts under a pressure corresponding to the external head under which the pump is working. The sectional arrangement given serves to indicate the arrangement of the impellers and the general details of the design.

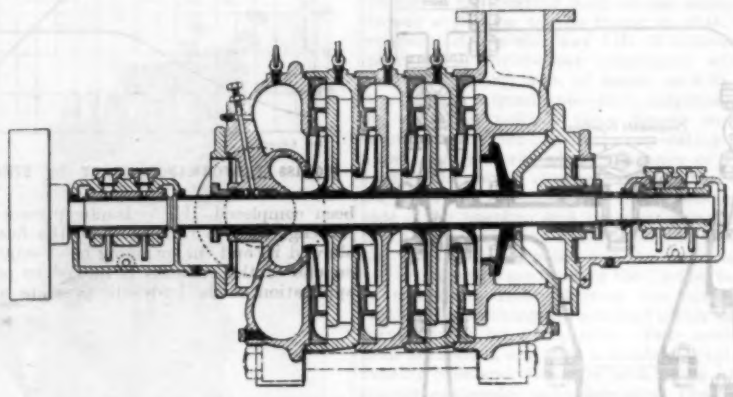


FIG. 189—MULTI-STAGE CENTRIFUGAL PUMP—MIRRLEES WATSON

Two single suction impellers are mounted on opposite sides of the pump suction A, and are so arranged that their inlets are facing each other, and the impellers discharge into volutes or pressure chambers B. These volutes are interconnected and join up to the common discharge pipe C. It may be noted that the two impellers work in parallel, their disposition being such that the end thrust of the one is counterbalanced by the end thrust of the other. The chambers D at opposite ends of the pump casing communicate with the inner ends of the stuffing-boxes, through which the impeller shaft passes, and they are also connected to the volutes by means of the clearance spaces at the peripheries of the impellers. Any possible communication between the chambers D and the suction inlet A is prevented by the impellers and the diaphragms E. The pressure in the chambers D, therefore, corresponds to the discharge head, and as this is well above atmospheric pressure, there is no tendency for air to enter the pump casing through the stuffing-boxes. As the design is intended for moderate discharge heads, the glands do not require to be very tight in order to prevent leakage. This type of pump would seem to eliminate completely what is undoubtedly one of the principal sources of air leakage in a closed feed system. It is strongly constructed and is designed for continuous working over long periods.

For circulating the cooling water through surface condensers and for other work demanding the movement of large quantities of water against small heads, the Mirrlees Watson Company makes a low-lift high-efficiency type of centrifugal pump. One of these pumps is exhibited, and it is opened up and partly dismantled, so as to show the details of design. An illustration of this type of pump is given in Fig. 192. Test curves of two pumps are shown in Fig. 190, and indicate the type of result obtained. We may call attention to the flatness of the efficiency curve, which shows that the pump maintains a high efficiency over a wide range of both quantity and head of water. The brake horse-power curve also rises to a certain value and then runs nearly horizontal, so that the driving motor, if rated slightly above the normal requirements of the pump, cannot be overloaded.

There are also exhibited examples of the firm's

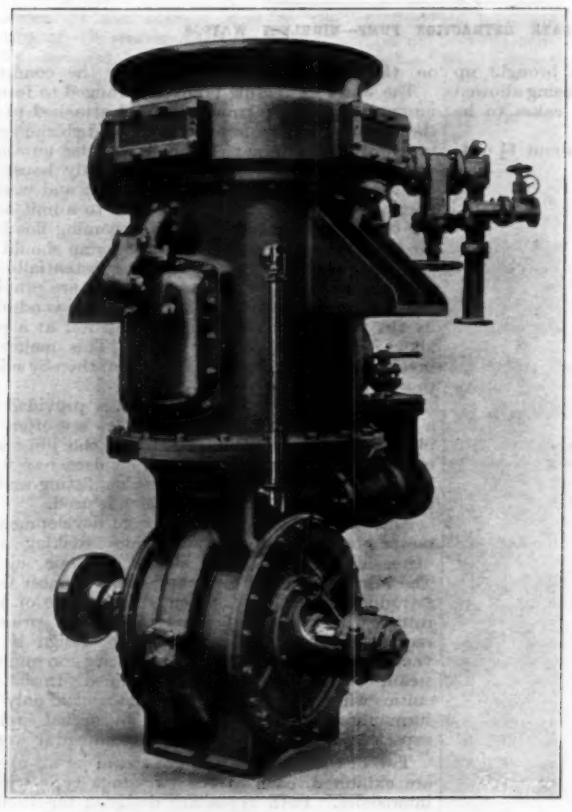


FIG. 191—JET CONDENSER—MIRRLEES WATSON

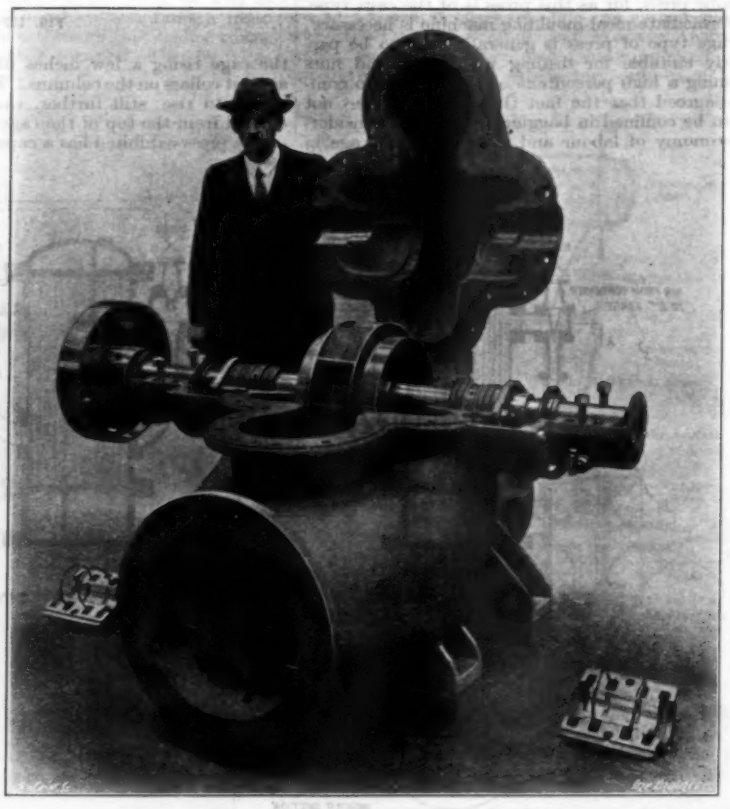


FIG. 192—LOW-LIFT CENTRIFUGAL PUMP—MIRRLEES WATSON

ring-type multi-stage centrifugal pumps, which can be built up to suit any required head by bolting together a proper number of interchangeable sections. These pumps are of robust and simple design for mine work and other heavy duties, and Fig. 193 shows a section through this type of pump.

The hydraulic balance is obtained by a disc of the double-face differential type, which has the advantage that even if unavoidable wear, brought about by gritty water or other causes, takes place, the impellers still maintain their correct normal position, instead of moving towards the suction end, as with the single-face type of disc.

The impellers and diffuser rings are made of a special high-tension bronze, and the walls of the water passages are highly finished to reduce friction losses. The outer bronze guide ring is carried round in an easy curve to the point where the water passes over into the suction passage to the following impeller. It will be seen that the rings are held in position by the tension of the tie bolts, and that no internal screws or fastenings of any kind are used. Bronze rings are fitted inside the pump at all points where wear is likely to occur, and they are made to gauge and can be easily replaced. The pump shaft is of ground nickel steel, and inside the pump it is protected by renewable bronze sleeves. Water-sealed stuffing-boxes are provided, and are so designed that the sealing water tends to pass outwards and to prevent air from entering the pump casing. Care has been taken in the design of the bearings, which are ring lubricated, the shaft being provided with oil throwers, while oil catchers prevent any waste of lubricating oil. The firm also builds similar pumps of the split barrel type. A portion of the company's works has now been set aside for pumps alone, and is equipped with very complete testing equipment.

THE NEW PELAPONE ENGINE COMPANY, LIMITED.

Among the various vertical enclosed petrol and paraffin engines which are displayed at Wembley, some new models are to be seen on the stand of the New Pelapone Engine Company, Limited, of Carr Bridge Works, Dewsbury. This firm has for some years specialised in small oil engines for industrial uses and country house lighting plants, and the type of engine which has been evolved is notable on account of its clean lines and sturdy design, its well-proportioned details, and the high standard of workmanship which inspection shows is bestowed in the building of the engines.

A prominent feature of the stand is a four-cylinder direct-coupled country house lighting plant, a replica of that recently supplied for the lighting of Goldsborough Hall, the Yorkshire residence of H.R.H. Princess Mary. The plant comprises a 18 brake horse-power four-cycle engine designed for using paraffin fuel, which is coupled direct to 10-kilowatt 100 to 140-volt direct-current generator. The engine has four 4¼in. diameter cylinders with a stroke of 5in., and it runs at a speed of 800 revolutions per minute. It is of the totally enclosed type, and is fitted throughout with forced lubrication. One of the features of the design is the plunger type lubricating oil pump and a neat type of oil filter which may be cleaned while the engine is running. The four cylinders are cast separately and are mounted on the upper half of the divided crank case. Particular attention has been paid to the water jacketing of the cylinder and valve spaces, and the cylinder jackets are extended so as to surround the valve chamber and spindles. At the top of each cylinder is a removable jacket head which connects with the water outlet pipe. The inlet and exhaust valves are placed alongside each other, and are operated by spring-controlled tappets driven from the solid cam shaft, which is housed in the upper part of the crank case. This shaft is driven from the crank shaft by cut spur gears. A ball type horizontal governor is provided at the end of the engine near the starting handle, and is arranged to run in an oil bath. The governor not only controls the quantity of mixture admitted to the cylinders, but it also automatically regulates the quality of the charge, thus ensuring very sensitive speed control. Where the engine is required to burn petrol a Zenith carburetter is employed, but for paraffin fuel the company's own Pelapone vaporiser is used. We were informed by the makers that this type of engine, in its larger sizes, has been very successfully employed for the driving of turbine fire pumps. Such installations have been supplied, we are informed, to a number of British aerodromes and also to mill sprinkler plants. In the case of a sprinkler installation the engine is brought into operation by means of a heavy electric starting gear of a similar type to that generally used for motor car starting work. After the engine has been started the pump maintains the pressure in the sprinkler system.

The illustrations accompanying this article serve to show various types of the latest pattern of Pelapone engine. Comparing it with the firm's earlier models, we note the general pleasing lines of the new design and the exceptionally large crank case inspection door which has been adopted. This door gives access to all reciprocating parts, crank shaft bearings and cam shaft gears. The crank shaft is of forged steel, and large-sized main bearings, 1¾in. diameter by 4in. long, are provided. A balanced crank is used, the balance weights being bolted on to the webs by a bolt running through the web, which is riveted over to make a secure fastening. The main bearings are ring oiled and, in addition, they are pump lubricated so that there is little chance of lubrication failing. Any oil overflowing from the bearings is brought back to the bottom end bearing of the connecting-rod, which is also furnished with an oil dipper. The top end of the rod is splash lubricated. Reference may be here made to the oil pump, which is of the plunger type driven from the crank shaft. The pump valves may be easily removed, and the main distributing duct is cast into the bed-plate and provided with inspection flanges, which permit the pipes supplying oil to the bearings to be withdrawn and cleaned. A simple straining device is fitted at the back of the engine, and oil sump filling and draining plugs at the front, as shown in illustrations Figs. 194 and 195. The valves, as in the previously described model, are placed side by side, and access is given to them through valve covers placed in the cylinder head. The tappets are exceptionally large, and they are offset in relation to the cams, so that a rotating motion is imparted to them. The two tappet guides are secured by one bolt and a bridge piece. The horizontal cam shaft also carries a ball type governor running in an oil bath, and it is driven from the crank shaft by 1¼ wide cut steel gears. Particular attention has been given to arrangement of the magneto, which is of the B.T.H. standard pattern, and is

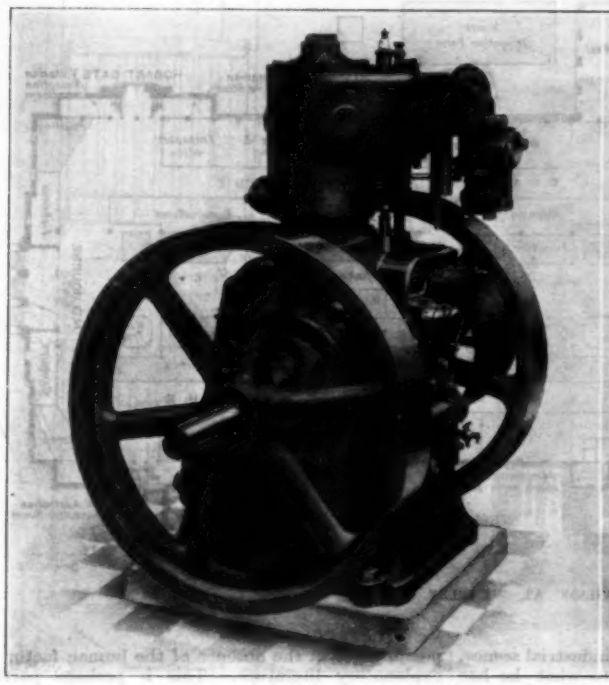


FIG. 194—4 B.H.P. SINGLE-CYLINDER PELAPONE ENGINE

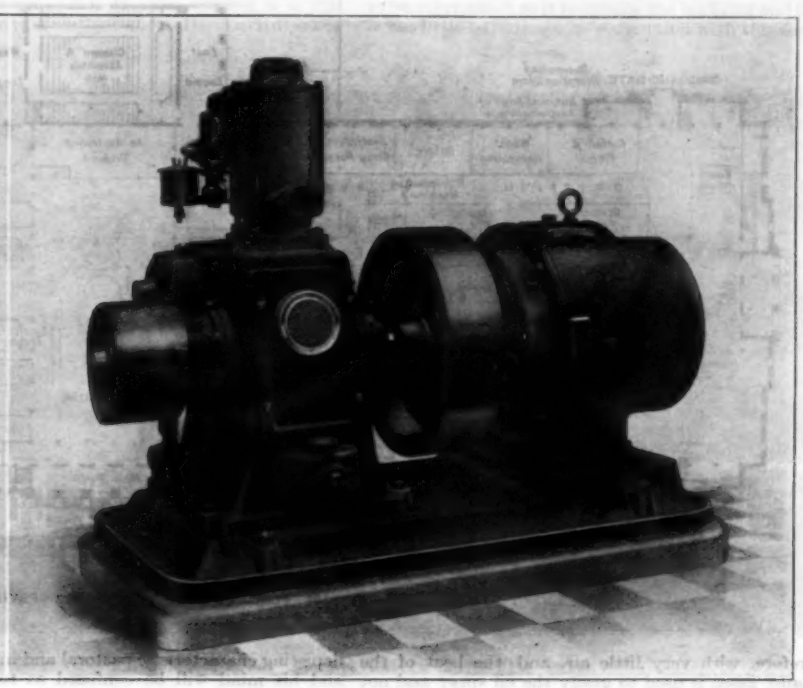


FIG. 195—2 K.W. PELAPONE LIGHTING SET

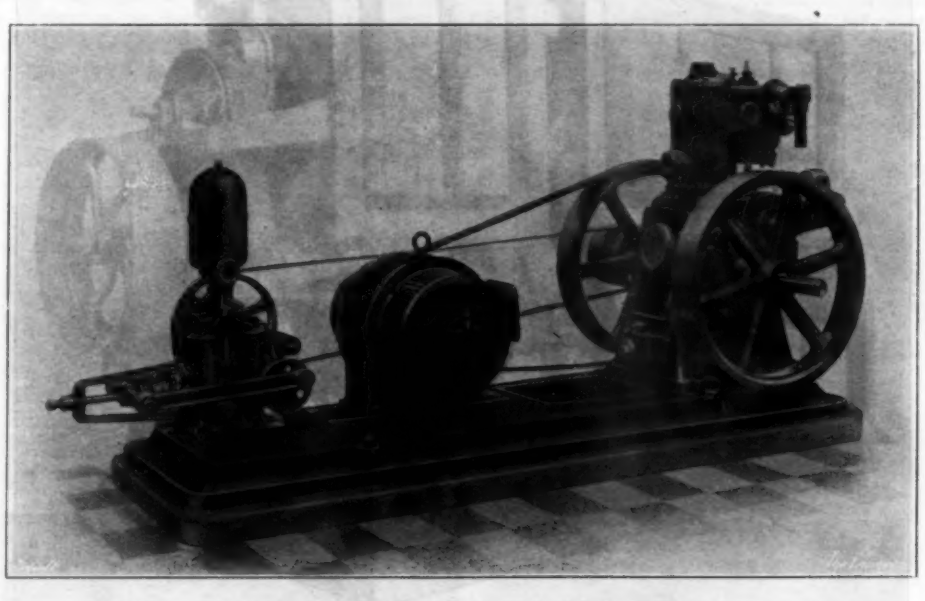


FIG. 196—PELAPONE COMBINED LIGHTING AND PUMPING SET

driven by skew gears from the end of the cam shaft. It is easily accessible, and the contact breaker points are placed in a position which permits of their easy examination.

We have already referred to the Pelapone type of paraffin vaporiser. This vaporiser has some new and interesting features. An ordinary type of float chamber is employed, with a choke tube of relatively small size compared with that used in general practice. The paraffin spray enters the vaporiser, therefore, with very little air, and the heat of the exhaust gases is used to gasify the oil spray and not to warm up and expand unnecessary air. The vaporising chamber is composed of a cylindrical tube with internal and external serrations, which provide a large surface. At the same time it is of such a form as to compensate for continued expansion and contraction and to give a permanently tight joint under all conditions. A triangular baffle is fitted in the vaporiser tube, which further disintegrates the oil spray and brings the oil into contact with the walls of the vaporiser. The main air is taken in through a separate inlet fitted with a hand-controlled throttle. The object of this separate air inlet is to cool but not to condense the ingoing mixture, so that a cool and dense charge is delivered to the engine cylinder, and any tendency to pre-ignition is avoided. The engine is arranged for starting on petrol. Like the model previously described, the cylinder is 4¼in. in diameter with a piston stroke of 5in., and it is designed to develop 4 brake horse-power when running at a speed of 400 revolutions per minute.

The engine shown in Fig. 194 represents the industrial type of engine, and it is supplied with two fly-wheels and a pulley for belt driving. A further model of this type is illustrated by Fig. 195, which shows a similar engine coupled direct to a 2-kilowatt lighting dynamo and mounted on a common base-plate. A flexible coupling is provided, and dynamos of 50 or 100 volts may be supplied as desired. A considerable advantage is gained by the introduction of a belt pulley on one side of the engine, as this arrangement permits of the driving of pumps, and agricultural or domestic machinery.

A further type of Pelapone lighting and pumping set is shown in Fig. 196. In this example a belt drive is used, and both the dynamo and the pump are mounted, together with the engine, on an extended cast iron bed-plate. Means are provided for adjusting the position of the generator and the pump so that a tight belt is always obtained. The pump is particularly neat in design. It is fitted with a large air vessel, and has easily accessible duplex suction and delivery valves.

Other exhibits on the stand include one of the firm's Pelapone De Luxe country-house lighting sets with a 2.5-kilowatt direct-current generator. The switchboards, which are shown in conjunction with the lighting sets, are all manufactured in the company's own works at Dewsbury, and boards of the hand-operated semi-automatic and full automatic types may be supplied as required. An outstanding feature of the design of the switchboard instruments, which we noted, was the very robust construction of the battery charging and discharging regulators. These regulators, as well as the switches, are designed for the severe handling which is, more often than not, meted out to them by gardeners and unskilled attendants who are generally deputed to attend to country-house lighting and pumping plants.

THE AUSTRALIAN SECTION.

Although "Canada" is only a few yards from "Australia"—at Wembley Park—it is a mistake for the engineering visitor to pass directly from the one to the other. If he does, two things will assuredly happen to him. He will afterwards mix up the exhibits in the two pavilions, for he will find in both fine displays of minerals, timbers, farm and dairy produce, frozen meats, elaborate vistascopic working models depicting characteristic pastoral and industrial scenes, and his mind will be confused as to what he has actually seen in either. He will, too, instinctively form a mental comparison between the two sections, and it will be somewhat to the detriment of Australia, because in it he will miss the quiet dignity of the Canadian section, where all is order and every department is under expert management, and nothing is bought or sold.

In Australia he finds an entirely different atmosphere. He is plunged suddenly into a huge bazaar or market where anything may be bought over the counter, from bread and cakes and apples and opals to boot polish and soft drinks. But the engineering visitor must not be deceived by this difference, for there is in reality a vast amount to interest him theoretically and practically. The Australian Section is a very fine display, and, generally speaking, has been well carried out. It represents a splendid effort on the part of the Commonwealth.

The only weak point about the engineering exhibits is that, as far as the machinery and kindred displays of the private firms are concerned, they are left to take care of themselves, without, except in one or two cases, any attendant to explain their virtues and give technical information.

The management appears to have concentrated on Government exhibits and on the more readily saleable products, which, we think, is a pity from the visitor's standpoint, because many of the machines are well worthy of more consideration than they can possibly get in the absence of the human factor and explanatory literature. This is perhaps partially to be accounted for by the fact that very few of the more than fifty exhibitors of machinery and accessories expect to find a market outside Australia for their goods. Their motive in nearly every case in sending their machinery half round the world to this Exhibition has been a purely patriotic one. The expense of so doing must have been very great, and certainly the machines deserve a better fate than to be placed, as it were, in a modern museum with no one to tell the tale and nothing to enlighten the visitor beyond a small card bearing the maker's name, supplemented in only a few cases by a few lines stating what a machine will do.

In the plan which we produce in Fig. 197, the exhibits which are of most direct interest to the engineer are shaded dark. It will be seen that most of them are concentrated towards the north-western corner of the building. Most of the Government exhibits are on both sides of the "Kingston-avenue,"

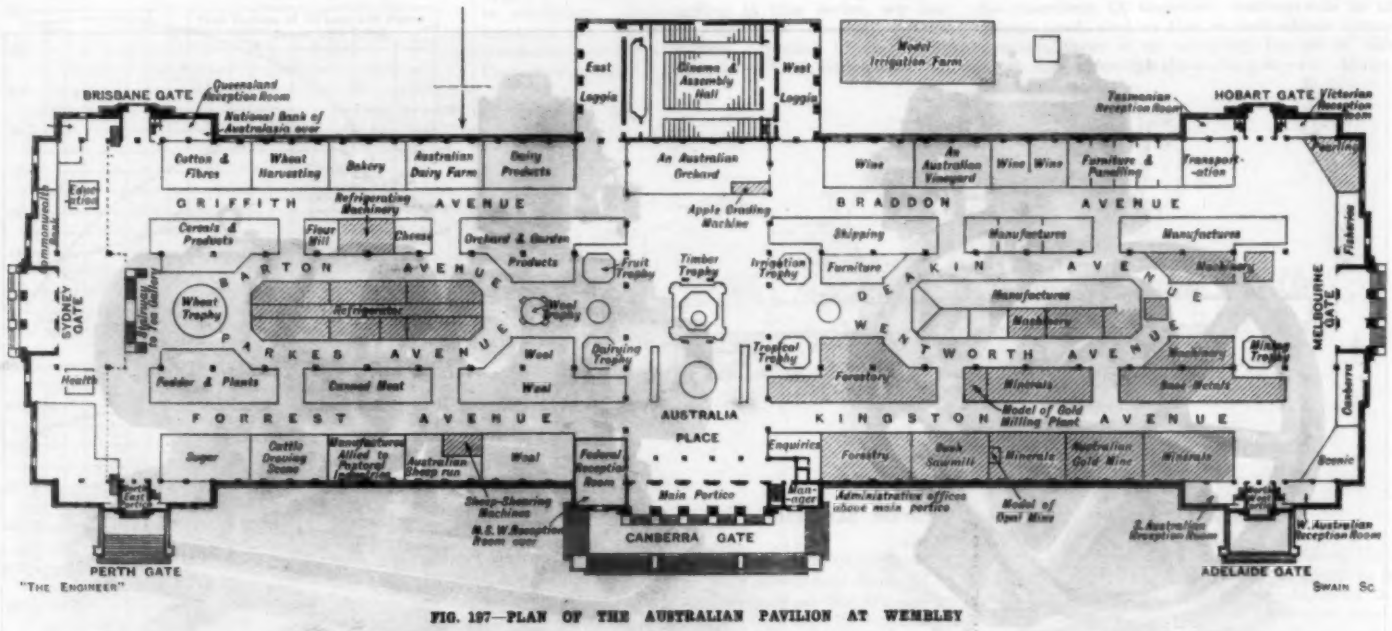


FIG. 197—PLAN OF THE AUSTRALIAN PAVILION AT WEMBLEY

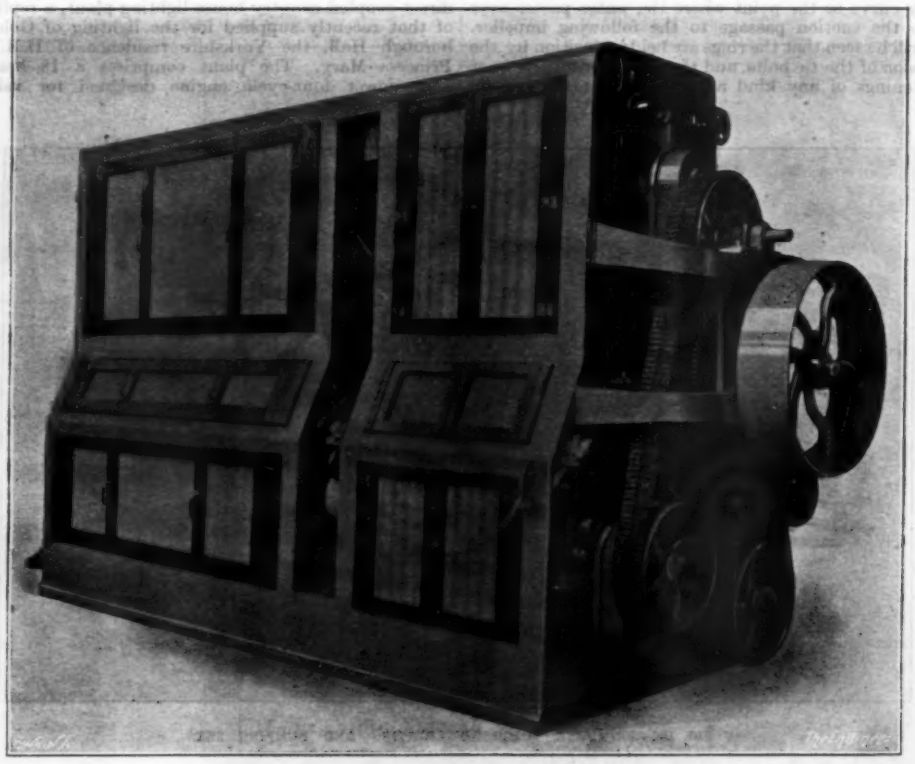


FIG. 198—"MIDGET" ROLLER FLOUR MILL—TATTERSALL AND CO.

though a few are mixed up with the exhibits of private firms elsewhere in the building, and two are actually outside it near the south-west corner.

MINING AND GEOLOGY.

All the States of the Commonwealth have contributed very generously to the engineering section, those of the Western Australian Government being perhaps the most prominent. The mining and geological section affords a formidable and comprehensive display which is under the direct management of representatives from each of the States concerned. Here we have a very large and varied collection of geological specimens representing in sample form the various minerals which go to make up Australia's annual output with a value of just about £20,000,000. Gold, of course, is the staple mineral product, while coal, silver, lead, copper and tin contribute largely, and their relative importance is in the order given. Among other minerals, of which specimens are shown, are aluminium, antimony, arsenic, bismuth, chromium, cobalt, manganese, molybdenum, osmiridium, platinum, radium, tungsten, sulphur, oil shale, and various stones, clays, sands, &c.

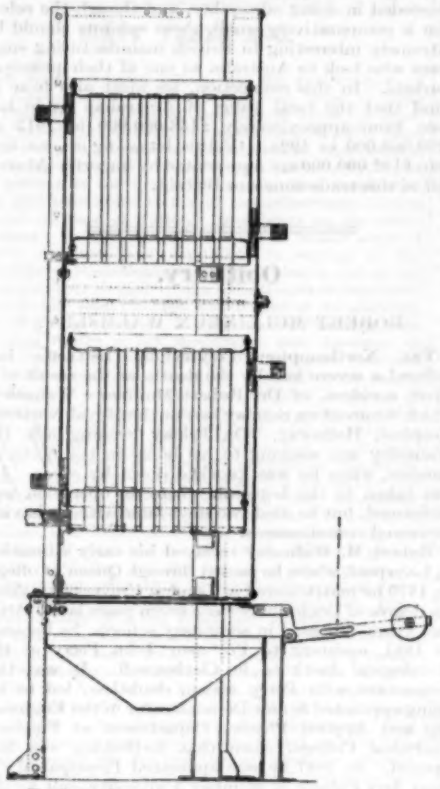


FIG. 199—TATTERSALL WHEAT MOLLIFIER

Exact replicas of many of the famous Australian gold nuggets of great size are shown, and a large panoramic working model of a typical State five-stamp battery, rock breaker and conveyor, such as are provided by the Government of Western Australia for aiding prospectors in opening up auriferous areas, is an attractive feature—see Fig. 200. In the foreground of this model are to be seen real logs and a timber carriage, and the working stamps behind them are actually about one-fifth full size. There are two other much smaller but beautifully made and more elaborate mining models, one being a very extensive gold-milling installation in operation, including the whole plant from the ore crushers and conveyors to the recovery of the pure gold. The other is a non-working but realistic model of an opal mine, showing in section the surface and underground workings. This model is formed entirely of opal-bearing rock and represents three and a-half years' work by a miner who was formerly a cabinet maker.

A very striking and instructive exhibit is a 12ft. model reproduction of the famous Broken Hill silver-lead-zinc lode. In this the positions of all the shafts are shown and the various levels are indicated.

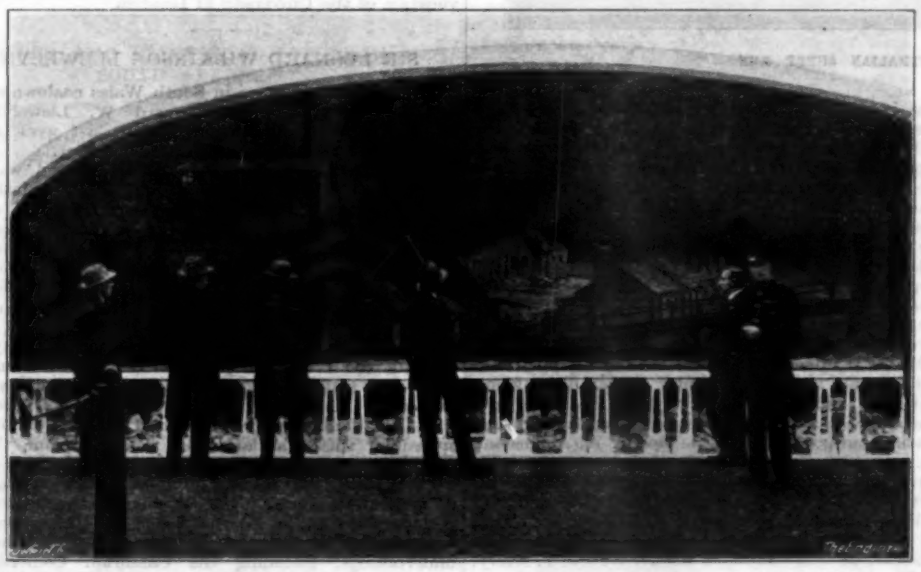


FIG. 200—MODEL OF AN AUSTRALIAN GOLD MINE

TIMBER POWER SUPPLY AND IRRIGATION.

Australia's 92,000,000 acres of forest land are well represented by samples of the various woods, some of which are well known in this country, whilst many are not. The feature in this exhibit which will interest engineers more particularly is the occular demonstration of the great durability of these woods when used for piles and railway sleepers. Here we have samples of timbers which have been submerged or above ground and between wind and water for periods varying from thirty to nearly a hundred years, the most striking example of which is a Tasmanian peppermint wood pile which was under water for ninety-three years. A red gum sleeper in use for sixty-three years is perfectly sound, as are also a Huon pine beam exposed for fifty-five years, an iron bark baulk which was taken from the overflow of a dam after fifty-two years' service and a jarrah pile submerged for sixty years.

Three other models which are worthy of notice are the panoramic working model of a typical bush saw mill—see Fig. 201—a life-size representation of pearl divers at work on the ocean bed and a bird's-eye model of the important hydro-electric works on Great Lake in Tasmania, which has a capacity of 63,000 brake horse-power. In this last are shown the supply reservoirs, their dams and channels, and the elaborate pipe lines to the power station. The delivery is, in the first place, effected by four wooden pipe lines, each 5ft. in diameter, and is eventually taken over by six steel pipe lines, with diameters of 3ft. and 4ft. The generating station and step-up plant—6600-88,000 volts—and the first portion of the power transmission cables to Launceston are shown.

One of the most interesting of all the Australian Government exhibits, but one that is almost certain to be overlooked, as it is outside the building and there is but little to indicate its connection with this section

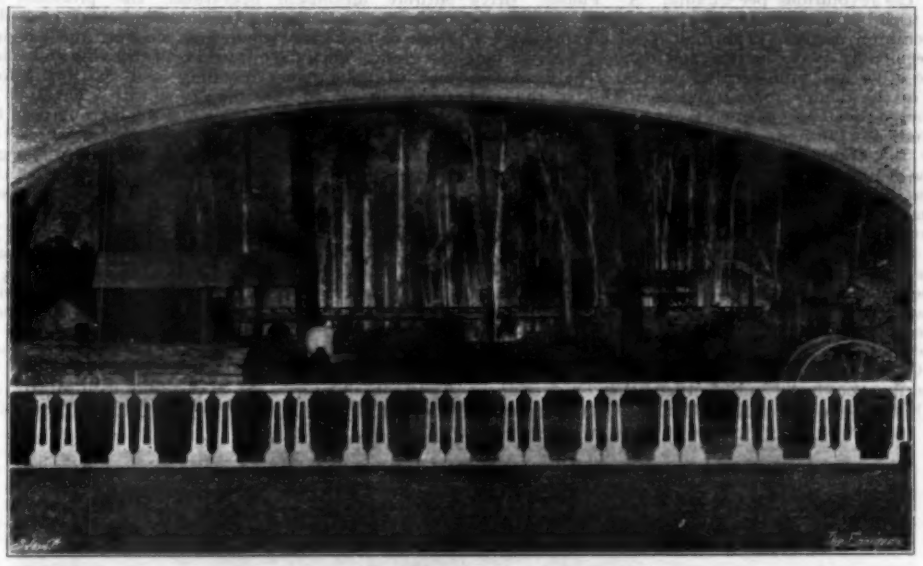


FIG. 201—MODEL OF AN AUSTRALIAN BUSH SAW MILL

or that it is there, is a splendid model, 70ft. long by 32ft., of an 80-acre irrigation farm, with the water circulating as in actual operation through the intersecting channels. Agriculture and stock raising alike are shown, and there are a vineyard and an orangery and other fruit-growing sections, machinery and implements, windmill and tank for a gravity house water supply, silo for making fodder "insulate," from the residue of the crops; fruit-drying racks, tram lines, and trucks are all there, as is also a typical homestead, with its farm buildings, even to a garage.

The Government undertakes the water supply to these properties. It is brought to a corner of the area to be irrigated, and a fixed charge is made for the quantity supplied, as measured by an inlet meter, which takes the form of a vaned water wheel to which is attached a cyclometer. The irrigation channels, which are formed in the natural soil, have a gentle gradient from start to finish. The growing crops of cereals and fruit are admirably counterfeited, and the whole is a perfect representation of a very important and gowing industry, which means much to Australian and home manufacturers.

MILLING AND REFRIGERATING.

Curiously enough, the two machinery exhibits in the Australian section which attract the most attention, because they are in full operation, are not Australian, but English, and are right away from the others. They are a flour mill by Messrs. A. R. Tattersall and Co., of Towcester, which serves to grind the wheat used in the Australian bakery hard by, and a refrigerating plant by the Lightfoot Refrigerating Company, of Birmingham, which serves a very large cold storage exhibit, 120ft. by 30ft., for meat and dairy produce.

The Tattersall plant shown—see Fig. 198—is one of the firm's "Midget" roller flour mills. The great feature in this machine is that, while it is self-contained, very simple and compact, and operates by a single belt driven by an electric motor, it converts wheat into high-grade white flour, bran and offals in a single operation. Its primary object is to encourage the local milling of wheat in the smaller rural districts, and thus compete with the elaborate flour mills in the larger towns, which up to now have absorbed the greater portion of the milling. In this new 1924 model, both the fluted and the smooth reduction rolls are kept in parallel by a patented double eccentric device, which operates, in the case of each pair, on the moveable roll. The adjustment of the roller is instantaneously effected by a hand wheel eccentric. After the first pair of break rolls, a vibrating sifter separates the "outsiftings" from the "tails," the former being passed to the flour dresser, and the latter dropping to the second break rolls. The dressing is done by four centrifugals and a sieve, which drops the bran and "sharps" into different sacks and returns the good residue for re-rolling. The installation is much simplified, as compared with the ordinary big mills, by the facts that

only one elevator is used, and that worm conveyors are entirely avoided. The roller and dressing sections are kept cool and dry by a fan. The output capacity is 250 lb. of wheat per hour.

This firm is also showing one of its "Invincible Mollifiers" for assimilating various wheats in a mixture and bringing them all to a uniform grinding level—see Fig. 199. This is done by the three consecutive processes of heating, stewing and cooling in a tall vertical column, at the top of which is the heating chamber or chambers in which the wheat passes by gravity through steam-heated tubes, and thence into the stewing section below.

The Lightfoot refrigerating plant consists of two horizontal open-type ammonia compressors, one running at 240 revolutions per minute and the other at 125 revolutions per minute. A "Flenco" drive is used for both, and they are driven by electric Crompton motors. The high-speed compressor has special disc plate suction and delivery valves, and the other has "mushroom" valves. The condenser is of the double type. The insulation of the cold storage rooms has been carried out by the Insulating Syndicate, Limited, and the recording instruments are by the Cambridge Instrument Company, Limited. The cooling is done by a combination of direct expansion pipes and cold brine storage tanks. Electric fans circulate the cold air, and thus maintain an even temperature after the plant is shut down.

A third English machinery exhibit consists of sheep-shearing machines by the Wolseley Sheep Shearing Machine Company, of Birmingham. These machines are shown in operation shearing actual sheep. A model of an Australian sheep run is also shown in Fig. 202.

Of the Australian firms which are exhibiting engineering products, *i.e.*, other than Government exhibits, there are no less than fifty-four, and among

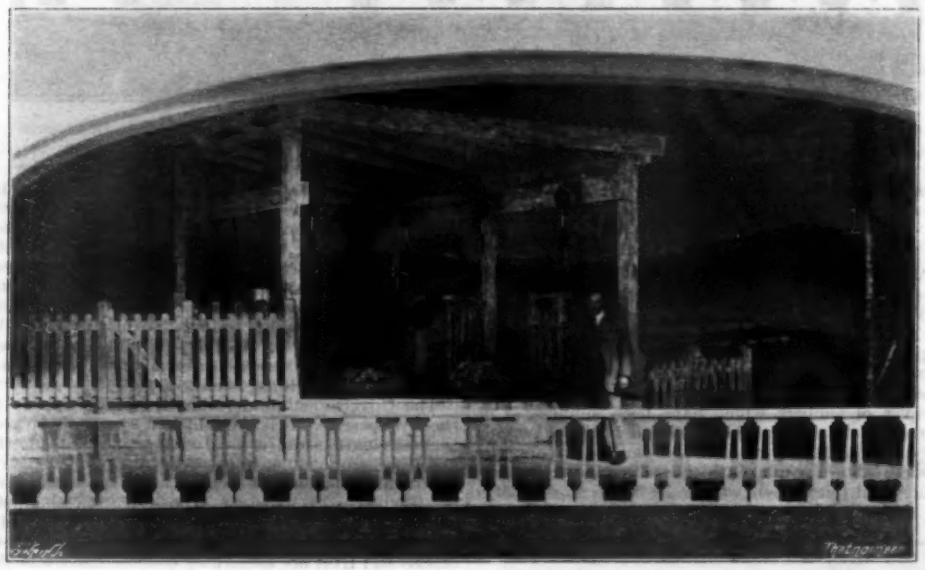


FIG. 202—MODEL OF AN AUSTRALIAN SHEEP RUN

the machines shown are many which would be worthy of notice at some length. Owing, however, to the almost total absence of attendants or literature at these various stands, already referred to, there is nothing to assist the visitor who would like to have more details than he can gain by a personal inspection of the visible parts. In view of these handicapping conditions, we are obliged to treat this department of the Australian section somewhat summarily, and to confine ourselves merely to enumerating the more important of these exhibits.

GENERAL EXHIBITS.

One of the most prominent and complete is the stand of the Broken Hill Proprietory Company, of Melbourne, which is showing a formidable array, set out in trophy form, of pig iron and steel ingots, wire, rods, rails, girders, joists, angles, and other constructional steel work as samples of its annual output of these products, which amounts to 1,200,000 tons. Messrs. Hadfields, of Western Australia, have samples of steel work, and the Government Railway workshops of the same State are showing a collection of their standard forgings, as used in locomotives and railway and tramway rolling stock. The Commonwealth Steel Products Company, of Brisbane, shows some excellent wheels, axles and tires for rolling stock, as used on the Queensland Railways. Motor parts, screws and nuts are exhibited by the Automatic Engineering Company, of Sydney; and Mr. E. Weir, of the same city, shows pipe bends, sleeves, collars, nipples, &c., in cast malleable iron. There is also a display of milling cutters and other tools by the Australian Tool Company, of Sydney.

Four firms are showing various classes of brass and copper work—namely, Messrs. A. W. Dobbie and Co., of Adelaide; the Austral Bronze Company of Sydney; the Metal Manufacturers, Limited, of Melbourne; and Messrs. Rankin and Bond, of Launceston, Tasmania. These exhibits include valves, pipes, tubes, rods, wires, telephone transmission cables and other industrial samples. Messrs. O. T. Lempriere and Co., of Sydney, are showing white anti-friction metals, and the Wilson Waratah Company, of Brisbane, some white metal bearings for railway axles.

Coming now to the machinery exhibits, the most striking is the colossal "header" automatic harvester by the McKay Proprietory Company, of Sunshine, Victoria. This machine occupies the whole of a prominent stand at the extreme west end of the building. It is, in fact, an ingenious combination of the familiar reaping machine and of the thrashing machine for cereals, and it performs, in a series of entirely automatic operations, the processes of gathering and reaping the standing crop, and also those of thrashing, winnowing, cleaning and bagging the grain. Thus the operations of sheaving and tying and of subsequent handling and carting before thrashing are entirely dispensed with. Great as is the utility and saving of time and labour effected by this machine in Australia and elsewhere where the stalks, &c., are not utilised, its practicability is negatived in Britain where these things are used, as the harvester takes nothing but the ears in the process of its work, and the stalks are burnt afterwards as refuse on the field. The same firm has elsewhere in the building two other machines, viz., a reaping and binding machine and a cultivator—a combination of the harrow, the manure distributor and the sower. The seeds and manure are carried in separate boxes, which distribute them as required, the last row of harrows being arranged to turn over the soil and cover the seeds. The Trewhella Proprietory Company, of Trentham, Victoria, has a very powerful apparatus, which is described as a "monkey winch." Its purpose is to fell trees and extract their roots simultaneously by human labour only, and it is claimed that with it two men can exert a pull of 24 tons. The apparatus is small, and easily carried or dragged from one position to another. It consists of a simple but strong winch and two lengths of steel cable. One of these, with a running noose at one end and a hook at the other, is passed round the trunk of the tree to be felled, and made fast to the winch. The other and longer one is passed round the base of another tree which is destined to afford the "purchase" to support the pull. The tightening is effected by the winch actuated by a hand lever operating on a ratchet wheel.

Messrs. Ronaldson Brothers and Tippett, of Ballarat, are showing a number of paraffin engines, and Mr. G. H. Nicholls, of Sydney, has an air-gas machine with a clock spring mechanism for lighting, heating and power purposes. Messrs. W. Adams and Co., of Sydney, show a small marine type reversible petrol engine, and also the only machine tool in this section, a well-built and substantial S.S. and S.C. lathe. A weighbridge and certain balances are shown by the Australian Scale Company, of Sydney—an offshoot, we understand, of Messrs. W. and T. Avery, of Birmingham. The Australian Oxygen and Industrial Gases Proprietory Company, of Melbourne, is showing welding and cutting torches and roller guides, while Mr. R. T. Cousins, of Sydney, shows a rapid hand crank forge.

The display of electrical plant is small, both as regards quantity and size, though in quality it is generally excellent. Messrs. O'Donnel and Griffin, of Sydney, are showing direct-current motors; the Sydney Dynamo and Motor Works and Messrs. W. Cumming and Co., of Melbourne, switchgear and circuit breakers; the Electric Control and Engineering Company, of Sydney, controllers, starters, regulators and brakes; the Electricity Meter Manufacturing Company, of Sydney, meters and parts; Messrs. Newton and McLaren, of Adelaide, electric fans; Messrs. Pickering and Godfrey, of Sydney, starting switches, knife switches and fuses; and Mr. Albert Johns, of Western Australia, an electrical incubator.

For the reasons given earlier in this article, Australia has not endeavoured to collect at Wembley a comprehensive series of machinery exhibits, but rather a series of representative samples which will serve to give an idea to the Empire of the lines on which she is working and the progress she has made. This she has succeeded in doing admirably, and though the selection is comparatively small, these exhibits should be extremely interesting to British manufacturing engineers who look to Australia as one of their principal markets. In this connection, we must also bear in mind that the total value of Australian trade has risen from approximately £158,000,000 in 1913 to £250,000,000 in 1924. Of this latter figure, no less than £132,000,000 are represented by imports. Almost half of this trade comes to Britain.

Obituary.

ROBERT MULLINEUX WALMSLEY.

THE Northampton Polytechnic Institute has suffered a severe loss by the death, as the result of a street accident, of Dr. Robert Mullineux Walmsley, which occurred on Sunday last at the Royal Northern Hospital, Holloway. On Friday evening last Dr. Walmsley was walking to his home in the north of London, when he was knocked down by a car. He was taken to the hopsital, where an operation was performed, but he died two days later without having recovered consciousness.

Robert M. Walmsley received his early education in Liverpool, where he passed through Queen's College. In 1879 he matriculated at London University, taking his degree of Doctor of Science seven years later. After two years' teaching in secondary schools, he became, in 1881, assistant to Professor John Perry at the Horological Institute in Clerkenwell. It was this connection with Perry which, doubtless, led to his being appointed Senior Demonstrator in the Engineering and Applied Physics Department at Finsbury Technical College, when that institution was first opened. In 1887 he was appointed Principal of the Sind Arts College of Bombay University, but he did not remain long in India, returning to this country in 1887 to become a professor in the City and Guilds (Engineering) College. Two years later he was made Professor of Electrical Engineering and Applied Physics at the Heriot-Watt College, Edinburgh, a position which he occupied for five years or so. It was in 1896 that he became Principal and Head of the Electrical Engineering Department of the Northampton Polytechnic Institute.

Dr. Walmsley, who was a Fellow of the Royal Society, became a member of the Institution of Electrical Engineers in 1890. He found time, in addition to his educational duties, to carry out a good deal of consulting work, of one kind and another, and he had for some years been a Senator and Chairman of Convocation of the University of London.

SIR LEONARD WILKINSON LLEWELYN.

A WELL-KNOWN figure in South Wales coalowning and mining circles—Sir Leonard W. Llewelyn, K.B.E.—died on Friday morning in last week at his home, Llanfrechfa Grange, near Newport.

Sir Leonard, who was born in 1874, and was, therefore, in his fifty-first year, was the son of the late Mr. Llewelyn Llewelyn, of Newport, who at one time was general manager of the Powell Duffryn Company. He was educated at the Monmouth Grammar School and at Cheltenham, after which he studied at Heidelberg. He served his apprenticeship to engineering at the Abersychan and Newport Abercarn Collieries, and after travelling abroad a good deal, became manager at the early age of twenty-four, of the Cambrian pits at Clydach Vale, and later was manager of the Ocean Coal Company's Collieries. He subsequently became again associated with the Cambrian Collieries, and was largely responsible, with the late Lord Rhondda, for the schemes of amalgamation which took place in connection with the Cambrian Combine. He continued as general manager of the Combine until the war period, when he joined the Ministry of Munitions, but retained his position as a director of the various undertakings, including the Cambrian Collieries, Limited, the Consolidated Cambrian, Limited, Celtic Collieries, Limited, D. Davis and Sons, Limited, Fernhill Collieries, Limited, Imperial Navigation Coal Company, Limited, the Glamorgan Coal Company, Limited, John Lysaght, Limited, North's Navigation Collieries, Limited, the Welsh Navigation Coal Company, Limited, the South Wales Power Company, and others.

Sir Leonard, who was a Deputy Director-General of Munitions Supply in the Ministry of Munitions, did valuable work for his country in connection with his duties, and in his first review of the work of the Ministry, Mr. Lloyd George stated that Sir Leonard had saved the country 20 millions of money.

by the judicious contracts which he had entered into. His life-saving work at colliery disasters in South Wales was known throughout the Principality. He was a past president of the Monmouthshire and South Wales Coalowners' Association, and of the Newport Chamber of Commerce; was vice-president of the South Wales Institute of Engineers, and he was also a member of the South Wales Coal Conciliation Board.

SIXTY YEARS AGO.

IN an article entitled "Notes on the Introduction of Steam Navigation," contributed to our issue of June 17th, 1864, by Mr. Joseph Chesborough Dyer, of Manchester, we are taken back to the summer of 1807, when Robert Fulton's steamboat demonstrated the success of her designer's ideas on the Hudson River. Mr. Dyer, if not present at the first trial, was in close touch with Fulton, and personally witnessed the triumphant success and rapid increase of Fulton's steamboats on the rivers of America. In 1811 he endeavoured to induce some of London's engineers and capitalists to engage in the introduction of steamboats on Fulton's plan to run on the Thames and other English rivers. His friends endeavoured to dissuade him from the idea, and in spite of the admitted success of Fulton's vessels, in spite of his obtaining from the United States a full description and drawings of Fulton's inventions and discoveries, he could convince no one that steamboats could be operated with safety and profit in the small rivers and crowded harbours of this country. Two years later, in the autumn of 1813, Bell's Comet was tried on the Clyde, and in 1814 the Margery, built by "the late Mr. Denny," at Dumbarton, for Mr. W. Anderson, of Glasgow, successfully completed a voyage to London, where she was sold for service on the Thames. The Margery was the first steamboat to ply in English waters. Her advent led in 1815 and 1816 to Boulton and Watt and other engineers taking up the building of steamboats. Mr. Dyer, although giving full praise to Fulton for the successful introduction of steam navigation, was thus apparently prevented only by the disbelief or caution of his countrymen from being the pioneer of a like movement in Europe. . . . A very fine piece of military engineering was recorded elsewhere in the same issue in the reprint of a report sent to Washington by Admiral Porter of the United States Navy. A fleet of Federal gunboats had been caught by low water above the falls at Alexandria on the Red River, a tributary of the Mississippi. The army was about to evacuate the region and preparations were being made to destroy the squadron to prevent its being of service to the rebels. Colonel Bailey, acting engineer of the Nineteenth Army Corps, proposed, however, a scheme, regarded at first as one of madness, whereby the vessels might be released by building a series of dams below the falls, so as to raise the water level sufficiently high to enable the gunboats to pass over the falls in safety. Ten days were available before the Army left, but in spite of a shortage of provisions and forage and of an accident due to an excess of water pressure on the eighth day, the enthusiastic work of some three thousand soldiers led to the dams being completed and the vessels released in safety. By the afternoon of, so far as we can follow the account, the thirteenth day, the squadron had been coaled and had its ammunition replaced and had started down the river with its convoy of transports. Under the best circumstances a private company, Admiral Porter added, could not have completed the work under a year.

COPPER AND ELECTRICAL POWER IN SOUTH AFRICA.

THERE are about 30,000 miles of telephone wires in South Africa. The communication system is being rapidly extended. During the year it is planned to open the Capetown–Johannesburg trunk. Within five years, thirty-five repeater stations will be in operation, making possible telephonic communication between any two points in the Union. In view of these developments and the accompanying industrial expansion which is taking place in South Africa, the importance of the manufacture of electrical equipment does not require further emphasis.

Copper is produced from two mines in South Africa. The Messina Mine in the Transvaal produces for export a partially refined ore varying in percentage of copper. The Cape Copper Company exports raw copper, running slightly over 98 per cent. copper. The peak production was reached in 1914, when 29,325 tons of ore running 43·72 per cent. of copper was exported. The total production for May, 1923, was about 650 tons of copper in the form of 500 tons of 68 per cent. copper and 230 tons of 97 per cent. copper. The total annual copper imports are valued at over £20,000, of which nearly £10,000 worth is manufactured copper. The total value of electrical equipment having copper in its construction—cable and wire, motors, transformers, &c.—is over £300,000 annually, excluding telephone and telegraph material, which is valued at about £30,000. With a large and increasing demand for electrical equipment, the establishment of the manufacture of such equipment in South Africa is certainly worthy of attention. With this question there is naturally connected that of the electrolytic refining of copper. On the coalfields of Natal and the Transvaal power can be generated at very low cost, and, provided a market for refined copper develops in South Africa, this branch of industry should offer very good prospects of success.

ENGINEERS representing financial interests in New York are looking into the possibilities of establishing a coke and by-product plant at St. John, New Brunswick, which it is estimated will cost in the vicinity of 1,250,000 dollars. The site of the proposed industry is on the property now occupied by the Maritime Nail Company, Limited.

Letters to the Editor.

(We do not hold ourselves responsible for the opinions of our correspondents.)

ORIGIN OF THE THRASHING MACHINE.

SIR,—*Re* John Rastrick's claim to be the inventor of the thrashing machine with fixed beaters, depicted in THE ENGINEER, March 8th, 1918, and his reference to the "law suit" mentioned in the issue of February 1st, 1918, in which Rastrick affirmed he was awarded "a tax cost of £123 10s. 6d.," considerable light is thrown on the matter in a pamphlet I found recently in the Patent Office Library, by one "Philo Veritas," 1811, entitled "The Thrashing Machine—An Address to the Public, but Most Particularly to the Landed Interest of Great Britain and Ireland."

An old controversy was apparently revived in 1810 by Sir John Sinclair appealing for subscriptions on behalf of Andrew Meikle, aged ninety-two, and styling Meikle "the sole original inventor of the thrashing machine." Sir Alexander Kinloch writes to Sir John Sinclair, January 1st, 1810, to the effect that, his brother and Mr. Rastrick being dead, he would assert:—"The honour and credit of the invention more properly belongs to the late Sir Francis Kinloch, my brother (assisted by the powerful mechanical genius of Mr. Rastrick, civil engineer at Morpeth);" though later he admits Rastrick "loudly taxed" his brother "with plagiarism." The "Dictionary of National Biography" records:—"About 1784 Francis Kinloch, a gentleman farmer, of Gilmerton, East Lothian, while travelling in Northumberland, saw a Thrashing Machine at Wark, and on returning home he caused a model to be made," this by Mr. Veitch, a Haddington watchmaker, which "was sent in 1784 to Meikle's shop, where it was tried at a high velocity, the machine being destroyed in the experiment." According to the author of the above-mentioned pamphlet, "lest it should rise up in judgment at a future period to the utter confusion of Mr. Meikle and his adherents," Sir Alexander Kinloch, in his letter, says he would ask Mr. Meikle:—"Does it not accord with your knowledge that Mr. Rastrick, civil engineer at Morpeth, entered a caveat against such your application (for a patent), stating that he and Sir Francis Kinloch were the original inventors of the Thrashing Machine?"

"Does it not also accord with your knowledge that Mr. Rastrick did insert in the Newcastle papers of 'Hue and Cry,' a letter addressed to the Farming Interest of the North of England, hailing them upon the overthrow of your application for a patent and congratulating himself on being the Author of it? To which letter, as far as I remember, no answer was given."

George Rennie replies to these questions from "Phantassie," January 6th, 1810:—"To the best of my knowledge neither Sir Francis Kinloch nor Mr. Rastrick entered a caveat against the Patent. Mr. Rastrick had the effrontery to insert a letter in one of the Newcastle Papers wherein he asserted that a jury had determined against the validity of Mr. Meikle's patent right. *As the matter had not then come before a jury*, and, strictly speaking, it never did come before a jury, a reply was immediately made by Mr. Meikle to that letter."

After writing to Sir John Sinclair, Sir Alexander Kinloch learned by a letter from Rastrick that the latter was "very much alive," Rastrick "complaining bitterly of the injustice done to himself and to the memory of the late Sir Francis Kinloch at Mr. Meikle's being so frequently mentioned in the public prints as 'the sole original inventor of the Thrashing Machine.'" The author of the pamphlet adds:—"It was a real pleasure to Sir Alexander Kinloch to receive a printed list of a most liberal subscription set on foot for the behoof of Mr. Rastrick by many of the most respectable Gentlemen in the North of England, wherein the Duke of Northumberland and Bishop of Durham were pleased to take a most conspicuous lead. He understands also that Mr. Rastrick intends to give the world the complete history *ab origine* of Mr. Meikle's unwarrantable interference with the credit of the invention." Meikle's patent was sealed on April 9th, 1788, and Mr. Walter Ross, his London agent, writes on March 8th, 1788:—"I have got your Patent at last to the Seals, it will be sealed upon the 10th of this month. I never knew anything create so much absurd trouble or so much injustice done to a man of your merit by a parcel of pretenders."

On page 436, Vol. IV., "Rural Cyclopedia," by Rev. John Wilson, Edinburgh, 1849, he states under "Thrashing Machines," that after Meikle had erected one for Mr. Selby at Middleton "one Northumberland millwright had the singular modesty to claim the invention," adding, "It is a singular circumstance, that though this patent was obtained at considerable expence, it was not acted upon."

Attached to another pamphlet, John Shirreff's "Reply to the Address, etc.," John Bailey, of Chillingham, writes, August 22nd, 1811:—"Mr. Wilkie's, of Hetton, was the first machine Mr. Rastrick built after Mr. Selby's had been erected by Mr. Meikle, but I have a print of a machine the same as he made for Mr. Wilkie dated 1780, and he says he built one soon after at Hadston the same as the print."

Mr. Robertson, civil engineer at Wooler Haughead, writes, August 31st, 1811:—"The first Thrashing Machine I built was for Mr. Wilkie of Dodington in the autumn of 1788, worked by two horses; and about the same time Mr. Rastrick built one for Mr. Wilkie of Hetton to go by water. The one I made in the thrashing and feeding parts was a true copy of one that Mr. Meikle had previously erected at Middleton, and the one at Hetton was not much different in the thrashing and feeding parts."

The "Dictionary of National Biography" relates that Sir John Sinclair raised £1500 for Meikle and that "it appears that only £85 was given in England, of which £21 was subscribed by two of his friends James Watt and John Rennie."

Careful perusal of the two pamphlets I quote from leaves little doubt in my mind that Rastrick should be credited with the invention.

ARTHUR LEE.

London, June 14th.

THE ENGINEERING INSTITUTIONS.

SIR,—It is hardly necessary to apologise for drawing attention to the multiplicity of engineering institutions at the present time. That they have been formed and are being formed is considered by some as proof that the existing and older institutions fail to meet the requirements of present-day excessive specialisation within the profession. Whether this is true or not, the creation of so many sectional institutions has very grave drawbacks. Large numbers of engineers, although they may be specialists, nevertheless require to keep in touch with broader issues and find themselves under the necessity to become members of several such bodies, while at the same time retaining their membership with the senior institutions. There is little doubt but that the senior institutions are weakened, perhaps seriously, through the creation of the sectional bodies.

Most professional men, in these days, find it a serious matter to meet the fees of some three or four societies, and have to choose between the junior body, from which they hope to obtain more value for their money, and the senior one, whose very broadness reduces its usefulness to them.

An alternative to the apparent endless formation of sectional institutions is to carry the professional section organisation of the American Society of Mechanical Engineers to a more complete stage.

Consider for a moment the whole field of professional engineering in the broadest possible way; this field is covered by the Institutions of Civil, Mechanical and Electrical Engineers, by the Institution of Naval Architects, the Iron and Steel Institute, and possibly one or two other bodies. These bodies now provide for the local as well as the national requirements of their members. These large institutions may be considered as forming the vertical divisions in the profession, but the horizontal or sectional division should be dealt with by the institutions and not by independant bodies. Now that there exists an Engineering Council, some attempt at co-ordinating the work of its constituent institutions is being made, and it is hoped that the Council will be the means of enabling the institutions to set up professional sections that will cut horizontally through all the senior institutions.

As an example, there is in this country a large number of engineers engaged on central power station work, either as designers, builders, or operators. But central power station work calls for knowledge of civil engineering, mechanical engineering, and electrical engineering. Why, therefore, should an engineer engaged upon such work have to join the Institutions of Civil Engineers, Mechanical Engineers, and also the Electrical Engineers? It should be sufficient for him to join one institution only, and by becoming a member of the power section obtain all the privileges of membership of the other institutions so far as the power section was concerned. He should be entitled to attend meetings, receive copies of all papers and discussions within the scope of the power section of the other institutions; various other privileges, such as use of the library, &c., could be granted.

What has been said for power engineers applies equally well for many other divisions of the profession. It is to be regretted that many of these have been covered by sectional institutions, but that does not mean that the senior institutions should refrain from forming sections in these subjects, since many of their members are not members of the new sectional institutions.

It may be said that the institutions would be put to extra expense without receiving extra fees. To a limited extent this may be true, but this should be more than compensated for by an increase in membership which would follow. Further, while membership of one section should be included with one institution membership, a small additional fee could reasonably be made for membership in additional sections not covered by the number of institution memberships; that is, an engineer with membership in two recognised institutions would pay an extra fee for membership in more than two sections, and so on.

Enough has been said to indicate the main idea of the scheme which is suggested as being helpful to professional engineers while increasing the activities of the senior institutions.

E. R. BRIGGS, M. Inst. C.E., M.I. Mech. E.

Rugby, June 16th.

STANDARD PIPE TAPS.

SIR,—After a close acquaintance with the use of British standard pipe taps of the taper variety, I have come to the conclusion that for best results the number of flutes must be limited and should be determined by the number of threads per inch, and not by the diameter of the tap, because the taper being fixed, the number of flutes determines the amount of work each cutting edge has to do.

For example, ¼in. and ⅜in. pipe taps have fourteen threads; then with three flutes we get $14 \times 3 = 42$ cutting edges to the inch to increase the diameter $^1/_{14}$, which is the taper per inch. Then with four flutes we have $14 \times 4 = 56$ cutting edges to do the same work. Now, if depth of cut has anything to do with the efficiency of the tap, then one of these must be better than the other. Further, take 1in., eleven threads, with four flutes, we get $11 \times 4 = 44$ cutting edges; but if we take 4in. with eight flutes we have 88 cutting edges. Plainly the depth of cut in the first case is twice that in the second, and if a tap of this description has too little to do, it is decidedly worse than slightly too much; also it will take more power, because it pushes its way through instead of freely cutting the metal out, and it is just this reason why I advocate for British standard pipe taps of the taper variety three flutes for 14-thread taps and four flutes for 11-thread taps, irrespective of size.

This letter would be of no interest to anyone if it agreed with general practice, but I think I am right in saying that tap manufacturers of America work to a standard which gives four and five flutes for 14-thread taps, and five, six and seven for 11½-thread taps, and eight, nine, ten, and eleven flutes for 8-thread taps, the number of flutes, of course, increasing with size of tap.

I do not know whether the tap manufacturers of England work to a common standard or not, but I do know that some of them increase the number of flutes according to size, and this, in my opinion, does not give best results.

If advocates of multi-fluted taps will compare by trial I have no doubt which will give best results under otherwise equal conditions.

My conclusion is that three flutes for 14-thread taps and four for 11-thread taps will have just sufficient depth of cut when at work to cut freely.

I believe that in America a 10in. pipe tap of eight threads has twenty flutes. It would be interesting to see this at work.

Birmingham, June 12th. S. E. ALLEN.

ACCORDING to statistics prepared by the Comité des Forges, the number of blast-furnaces in blast in France on May 1st was 136, the same number as for the preceding month. The number of furnaces ready to operate was 39, and that of furnaces under construction or repair 45. Pig iron production during April reached 651,323 tons, an increase of 16,759 tons compared with the previous month. The production of steel, 567,485 tons, showed a slight decrease of 5431 tons. The share of dis annexed Lorraine was 250,181 tons of pig iron and 187,543 tons of steel, against 245,561 and 191,074 tons respectively for March. The tonnage of pig iron produced during April was the largest since the Armistice.

Main Line Railway Electrification.

By Sir PHILIP DAWSON, M. Inst. C.E., &c., Consulting Engineer, and
S. PARKER SMITH, D.Sc., M.I.E.E., Professor of Electrical Engineering, Royal Technical College, Glasgow.

No. III.* (SWITZERLAND).

(4) D. The Swiss Federal Railways: Simplon Tunnel and Brigue–Sitten Three-phase Lines.

The Simplon Tunnel 3000-volt, 15-cycle electrification was the first important work of this nature undertaken in Switzerland. The tunnel, 19.8 kiloms. long, the longest railway tunnel in the world, has been operated electrically since its opening in 1906 in time for the Turin Exhibition. The contractors—Messrs. Brown, Boveri and Co.—undertook the work at their own risk, and by utilising the three-phase plant installed for tunnelling operations, and taking over two Valtellina locomotives nearing completion, success was achieved by the specified date. Each track has its own tunnel, the second having been opened since the conclusion of the late war.

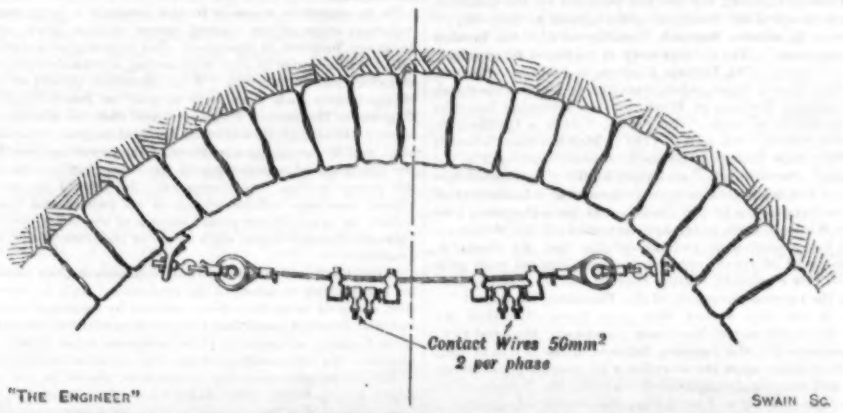


FIG. 7—OVERHEAD CONTACT-LINE CONSTRUCTION—SWISS FEDERAL RAILWAYS, SIMPLON TUNNEL

Ventilation of the tunnel is effected from the north—Brigue—end. This is important owing to the hot springs in the tunnel making the air very warm and moist, and causing a serious strain on the insulation. The speed of the fan motor at Brigue is adjusted according to the difference in barometric conditions between Brigue and Iselle, the southern termination of the tunnel electrification.

Owing to the great coal shortage after the war, and for better utilisation of the existing power station and the locomotives, the Rhone Valley line between Sitten (Sion) and Brigue was provisionally electrified in 1919 on the three-phase system, making a total length, when linked with the tunnel line, of 76 kiloms. Power for this service is obtained from Massaboden hydro-electric station, on the river Rhone near Brigue, working in parallel with the Cairasca station in Italy.

It is intended to convert the Brigue–Sitten section to single-phase working, to link up with the Sitten–Lausanne line, leaving the tunnel electrification to join with the Italian schemes on the south of the Alps. The Brigue–Sitten line will then be fed from the Barberine stations in the Rhone Valley through a substation at Gampel.

An interesting innovation in the design of electric locomotives—see the Supplement Drawing*—consisted in the use of three-phase squirrel-cage motors on the D type locomotive. The drive in this case is by a form of rectangular frame. The oldest type is the 1906 1 C 1 locomotives, which were equipped with Scotch yokes or "Kando frames." The recent 1 D 1 type has connecting-rod drive direct on to the coupling rods without a jackshaft. Some trouble has been experienced with these locomotives, and they will be altered by coupling the motor cranks through a third connecting-rod, as shown. Locomotive data are given in Table XI—page 634 *ante*.

The overhead construction is very simple. (See Fig. 7). In the open, iron tubing is used for frameworks, the contact lines being suspended from cross wires. No form of catenary support is used. In the tunnel itself the conductors are carried by means of special insulators from copper-plated steel cross wires, stretched between gun-metal studs grouted into the face of the tunnel. The insulators are capable of withstanding 40,000 volts.

(4) E. Freiburg–Murten–Ins Railway.

This is one of the few direct-current railways in Switzerland worked by third rail; it is supplied from a hydro-electric station—Hauterive—of the Freiburg Canton. With regard to track, gauge, and train composition it is a main line, but has only light traffic. Accumulator sub-stations are used to enable a fairly small water power to be used, and for load factor improvement. It was opened in 1903, and is 33 kiloms. long. There are some other unimportant lines using direct-current at high tension.

* No. I., with Supplements, appeared June 6th. No. II. appeared June 13th.

(4) F. Burgdorf–Thun Railway.

The Burgdorf-Thun line—electrified in 1899—was the first in Switzerland to be worked on the three-phase system—750 volts, 40 periods—and was electrified to deal with fairly dense traffic, to utilise available water power, and to avoid the heavy coal consumption with steam traction which was occasioned by the gradients and curves. The traffic is all electric, goods trains being hauled by locomotives, and passenger trains by locomotives or motor-coaches. The section Burgdorf-Langnau of this line was opened in 1919, and a further section, Burgdorf-Solothurn, is being studied.

The Burgdorf-Thun locomotives for goods haulage are shown diagrammatically in the Supplement Drawing. Both the later B–B types have the motors mounted directly, one on each bogie frame. The locomotive No. 4 has the four speeds; 14, 20, 29 and 44 kiloms. per hour, corresponding to 12, 8, 6 and 4 poles on the motor fields, while the No. 3 locomotive has approximately the same speeds with 16, 12, 8 and 6 poles. The oldest locomotives—Nos. 1 and 2—have only two speeds—18 and 36 kiloms. per hour—effected by changing the gear ratio.

(5) Results of Electrification.

(*a*) *Energy Consumption.*—Table VII. contains the results obtained on the Loetschberg, the Rhaetian, and the Swiss Federal Railways for the years indicated.

TABLE VII.—*Mean Annual Consumption of Energy, W-h per t-km.*

Year.	Loetschberg Railway. W-h per t-km.*	Rhaetian Railway. W-h per t-km.†	Swiss Federal Railway (Erstfeld–Biasca). W-h per t-km.‡
1913	51.5	47.8	—
1914	51.1	48.8	—
1915	50.4	51.9	—
1916	47.9	51.6	—
1917	52.6	52.6	—
1918	52.9	51.6	—
1919	52.5	—	—
1920	50.5	—	48.0
Mean	51.0	50.7	48.0

* Measured at the contact wire supply terminals at Spiez and Kandergrund.

† Measured at the contact wire supply terminals at Bevers. The two first columns in the table do not, therefore, include the transformer losses or the losses in transmission from power station to sub-stations.

‡ Measured at the switchboard at Ritom power station for the five months September, 1920, to January, 1921.

All the above figures are for working without regeneration of energy by the locomotives; they are not comparable among themselves on account of train heating, which is included entirely in the Rhaetian figures, and only in part in the Loetschberg results.

All the above sections are mountain lines. It is interesting to compare the figure 35 W-h. per t.-km.—measured at Spiez Station—for the Berne–Scherzligen section, which has easy gradients and practically no shunting.

(*b*) *Electric Locomotive Maintenance.*—Table VIII. shows the cost of maintenance of the electric locomotives as compared with steam locomotives on the Loetschberg and Rhaetian lines.

TABLE VIII.—*Locomotive Maintenance Costs.*

Loetschberg Railway.

	Steam. Locomotive-km.	Steam. Centimes per loco.-km.	Electric. Locomotive-km.	Electric. Centimes per loco.-km.
1915	325,114	20.00	584,474	15.20
1916	225,545	44.30	502,863	23.60
1917	177,597	52.80	508,186	30.00
1918	196,409	50.00	448,438	46.80
1919	184,370	68.80	627,049	61.50
Mean		43.2		35.8

Rhaetian Railway.

	Steam. Locomotive-km.	Steam. Centimes per loco.-km.	Electric. Locomotive-km.	Electric. Centimes per loco.-km.
1915	1,070,000	26.42	299,000	10.75
1916	1,107,000	24.28	269,000	13.79
1917	1,025,000	22.30	259,000	21.90
1918	805,000	38.31	254,000	22.23
1919	728,000	42.75	362,000	36.02
Mean		29.7		21.7

Thus the mean maintenance cost of the normal-gauge electric locomotives on the Loetschberg line per locomotive-km. is about 17 per cent. less than the mean cost for steam locomotives during the years specified. The Rhaetian Railway figures refer to steam and electric locomotives of the same power. The electric locomotives date from 1912, whereas the steam locomotives are older. On the other hand, the Loetschberg figures relate to electric locomotives of 2000–2500 horse-power dating from 1910, and to steam locomotives of less than one-half this power, dating from 1900–1910. The figures are not strictly comparable in the light of the rather different service which the electric and steam locomotives provided.

Remarks re Tables IX.—The data regarding ton-kiloms. and costs have been taken from the statistics of the Swiss Federal Railways; all figures have been rounded off.

It must be noted that the three years compared are years during which the traffic conditions were not stable, as the ton-kiloms. for electric and steam service present very great differences. If we compare years 1920 and 1922 where the ton-kiloms. are approximately the same, the influence of the increase in development of electrified system is apparent. During the year 1920 the "electric" ton-kiloms. amounted to 3¼ per cent. of the "steam" ton-kiloms., while in 1922 they reached 21 per cent.

Particulars are given for all the steam locomotives—A–E types—as well as data regarding the steam locomotives of the A–C types alone, as a comparison with all the steam locomotives would be incorrect in view of the fact that the electric locomotives belong to the latter types. The types A–C include the locomotives with a speed of 75 kiloms. per hour, and over down to 60 kiloms. per hour; the types D and E represent locomotives with speeds of 55 kiloms. per hour and under.

It will be seen that the maintenance costs for year 1921 are high when compared with those for years 1920 and 1922. The increase from 1920 to 1921 is in per cent. larger for steam locomotives than for electric locomotives. On the other hand, the decrease from 1921 to 1922 is considerably less for steam locomotives than for electric locomotives. This may be ascribed to the fact that the maintenance and repair staff had in the meantime become more accustomed to the handling of electric locomotives and that the cost of work was thereby reduced.

(*c*) *Locomotive Tests.*—The following figures relate to a test run from Lucerne to Chiasso and back on the Swiss Federal line, carried out on September 24th, 1922:—

Locomotive.—No. 12,328; type 1 B–B 1; weight, 110 tons.
Trains.—Nos. 884 and 885; weight, 302 tons.
Total Weight.—412 tons.
Distance (Double Journey).—450.2 kiloms.
Schedule Speed (excluding Stop at Chiasso).—63 kiloms. per hour.
H.P.-Hours per ton Recorded at Draw Bar.—14.1, equivalent to 23 watt-hours per ton-kilometre.
Total Ton-kilometres.—412 × 450.2 = 185,500.
Energy Consumption at Pantograph.—5465.6 kilowatt-hours.
Specific Energy Consumption.—$1000 \times \frac{5465.6}{185,500} = 29.5$ watt-hours per metric ton-kilometre = 47.5 watt-hours per British ton-mile.
Locomotive Efficiency (Pantograph to Draw Bar).—$100 \times \frac{23}{29.5}$ = 78 per cent.

(*d*) *Electric Braking.*—The statement below was made by M. Weiss (Electrical Engineer to the Federal Railways) at Ulm on June 4th, 1923:—Steam locomotives were not, as a rule, braked on long steep gradients, in order to avoid the heating and consequent loosening of the wheel tires. With the advent of electric train haulage, locomotive wheel braking was also avoided, particularly because of the bad effects on the motors of the fine metallic dust produced during application of the brakes. It was, however, clear that for long descents electric locomotives should be provided with some means of electric braking, so that when running light the application of mechanical brakes would not be necessary. That a second form of braking was essential for lines of a steep character was indicated by the accident which occurred on the Loetschberg line in 1919, when, in consequence of the presence of a large stone on the track, the brake-rod of an electric locomotive was broken, so that the engine, with its attached passenger coach, ran through the terminal station at Brigue at over 100 kiloms. per hour, being subsequently derailed on a curve.

As regards the type of electric braking—i.e., rheostatic or recuperative—the possibility of the return of energy to the line is not of paramount importance under Swiss conditions, where the source of power is hydraulic. Moreover, the efficiency of the simplest recuperative equipment is, according to Dr. Behn-Eschenburg, rather low. The results of a test run, from Erstfeld to Bellinzona and back, showed a return of only 6 per cent. of the total energy expended during the double journey, at a mean power factor of 0.4.

On the Swiss Federal Railways, in usual working with either rheostatic or recuperative braking, only the locomotive weight is braked. Furthermore, rheostatic braking is usually employed only for locomotives running light. Although rheostatic braking is itself independent of the line voltage, it is not desirable, in most cases, to lower the collectors, since the ventilation system is thereby

cut out. An air pump, worked from the driving mechanism, is, however, used in addition to the motor compressor.

The experience on the Federal Railways leads to the conclusion that some form of rheostatic brake should be provided for electric locomotives working on lines with heavy gradients; for level track services the use of such expensive and heavy equipment can be avoided.

(e) *Interference Investigations on Berne-Thun Line.*—The line Berne-Thun has been used for experimental work on telephonic interference, the tests being made between 11 p.m. and 5 a.m. For the investigation of statically induced pressures, the contact line in Thun was connected directly to the insulated pole of the generator or terminal of the main transformer, while the other end (at Ostermundigen) was left free. For the measurement of magnetically induced pressures, a short circuit was placed at any desired point, and the excitation of the generator at Spiez adjusted to give a constant short-circuit current of 100 ampères. The results are summarised briefly below:

(i) *Electro-static Pressures.*

(1) It was found that the two feeding lines, carried on the same supports as the contact lines, to a great extent neutralised the effect of the latter, and the best position for the feeding lines was defined. (N.B.—On this section the railway is double-tracked, and the communication circuits run along one side.)

(2) The transposition of the communication lines every 500 m. was found to be insufficient to give good symmetry.

(3) Noises in telephones, consequent upon static pressures and dissymmetry, could not be obviated by discharging coils.

(ii) *Electro-magnetic Pressures.*

(1) The induction pressure in a communication line running beside the railway was about 5 volts per 100 a.-km. (ampère-kilometres). In the Spiez–Scherzligen telephone cable this amounted to 1.75 volts per 100 a.-km. with the current flowing in the nearest contact wire. It was found to be dangerous to touch a wire under the influence of dynamic induction if one were standing on wet ground. It was further noticed that, in consequence of crackling noises, working of the telephone might, in certain circumstances, be affected.

(2) The parallel connection of insulated return conductors to the rails was of little avail.

(3) The use of "milking" transformers without an insulated return conductor was not to be recommended, as the compensating effect was small.

(4) "Milking" transformers with insulated return might sometimes cause over-compensation.

(5) By judicious choice and proper lay-out of the insulated return, complete compensation of the induction pressure could be obtained with milking transformers having shunted primary windings.

(6) With the indirect feeding three-wire system and the four auto-transformers (at Thun, Kiesen, Rubigen and Ostermundigen), practically complete compensation was obtained if the insulated terminal of the generator were connected with the feeding line.

(7) If the unearthed terminal of the generator were connected to the contact line, the compensation obtained was only 50 per cent. of that for the two-wire system.

Conclusions.

(i.) With the ordinary two-wire arrangement it is impossible to prevent interference with communication air lines running beside the track.

(ii.) By means of milking transformers the dynamic induction pressures can be sufficiently decreased, even when the communication lines are but 5 metres from the rail axis (transposition and metallic circuits are assumed). The transformers are connected with the primary windings in series with the contact line, the secondary windings in series with an insulated return wire, and the mid-points of the secondary windings connected to the track. Complete freedom from interference is only possible when a counter-pressure wire is also used.

The mean distance of 5 kiloms. between milking transformers must not be exceeded.

(iii.) With the three-wire system using auto-transformers the communication circuits can be made free from interference. The system must conform to the following conditions:—

The length of line per auto-transformer must not exceed 10 kiloms.

The insulated pole of the supply must be connected to the feeder wires, *i.e.*, indirect feeding.

The position of the feeder wires on the contact line supports must be chosen to give the best compensation.

TABLE IX.—*Comparison of Operating and Maintenance Costs of Electric and Steam Locomotives of the Swiss Federal Railways for 1920–1922.*

(1) *Gross Ton-kilometres (excluding Locomotive).*

	1920.	1921.	1922.
Single-phase locomotives	144,901,000	468,027,000	947,155,000
Three-phase locomotives	68,628,000	113,278,000	109,583,000
Electric locomotives together	213,530,000	581,305,000	1,056,743,000
Steam locomotives, A–E	6,045,004,000	5,094,493,000	5,048,063,000
Steam locomotives, A–C	5,543,721,000	4,683,535,000	4,659,340,000

(2) *Operating Costs.**

	1920.		1921.		1922.	
	a.	*b.*	*a.*	*b.*	*a.*	*b.*
Single-phase locomotives	330,400	2.28	1,320,000	2.82	1,908,000	2.02
Three-phase locomotives	141,800	2.06	223,000	1.97	222,000	2.02
Electric locomotives together	472,200	2.21	1,544,000	2.66	2,130,000	2.02
Steam locomotives, A–E	16,003,000	2.64	16,592,000	3.26	15,173,000	3.01
Steam locomotives, A–C	11,854,000	2.14	12,768,000	2.73	11,615,000	2.50

(3) *Cost of Energy (for Electric Locomotives) and of Fuel (for Steam Locomotives).**

	1920.		1921.		1922.	
	a.	*b.*	*a.*	*b.*	*a.*	*b.*
Single-phase locomotives	—	—	2,317,000	4.95	4,420,000	4.66
Three-phase locomotives	—	—	178,500	1.37	268,500	2.45
Electric locomotives together	—	—	2,495,500	4.30	4,688,500	4.44
Steam locomotives, A–E	90,164,000	14.90	78,486,000	15.40	70,825,000	14.0
Steam locomotives, A–C	70,092,000	12.70	61,282,000	13.10	55,532,000	11.90
Price of coal per ton	174.38f.		174.25f.		158.42f.	

(4) *Cost of Lubricants.**

	1920.		1921.		1922.	
	a.	*b.*	*a.*	*b.*	*a.*	*b.*
Single-phase locomotives	22,500	0.155	54,800	0.12	52,200	0.055
Three-phase locomotives	6,200	0.09	9,500	0.08	5,400	0.05
Electric locomotives together	28,700	0.13	64,300	0.11	57,600	0.055
Steam locomotives, A–E	816,000	0.135	813,000	0.16	462,000	0.09
Steam locomotives, A–C	635,000	0.115	642,000	0.14	365,000	0.08

* Swiss Francs (Col. *a*): Swiss Francs per 1000 gross ton-kiloms. (Col. *b*).

(5) *Cost of Maintenance* (M), *of Energy* (E) *for Electric Locomotives, and of Fuel for Steam Locomotives, and of Lubricants* (L) *in Francs per* 1000 *Gross Ton-kilometres (excluding Locomotive).*

	1920.				1921.				1922.			
	M.	E.	L.	Total.	M.	E.	L.	Total.	M.	E.	L.	Total.
Single-phase locomotives	2.28	—	0.155	—	2.82	4.95	0.12	7.89	2.02	4.66	0.055	6.735
Three-phase locomotives	2.06	—	0.09	—	1.97	1.37	0.08	3.42	2.02	2.46	0.05	4.53
Electric locomotives together	2.21	—	0.13	—	2.66	4.30	0.11	7.07	2.02	4.45	0.055	6.525
Steam locomotives, A–E	2.64	14.90	0.135	17.675	3.26	15.40	0.16	18.82	3.01	14.60	0.09	17.10
Steam locomotives, A–C	2.14	12.70	0.115	14.955	2.73	13.10	0.14	15.97	2.50	11.90	0.08	14.48

M = Cost of maintenance. E = Cost of energy. E = Cost of fuel. L = Cost of lubricants.

The International Congress of Refrigeration.

THE International Congress of Refrigeration, which is now in progress in London, and which, as far as the reading and discussion of papers is concerned, ends to-day, is the fourth of the series. The Institut International du Froid, which is the permanent official body, was formed on the occasion of the International Conference in Paris in 1919. It is an organisation of States in which each country is represented by delegates, and some forty countries have accepted the convention, which was signed in June, 1920. The main objects of the Institute are to stimulate the teaching of the science and practice of refrigeration, to organise technical researches, and to deal generally with questions relating to the conservation, transit, and distribution of perishable produce.

The holding of the fourth Congress in London is a recognition of the important place occupied by Great Britain in handling refrigerated produce and of the developments on the technical side with which British engineers have been associated. It was into the Port of London that early cargoes of refrigerated produce were imported, and London is to-day the chief centre in the world of this traffic, and has made lavish provision for its reception in cold storage.

The subjects brought under review at the Congress have ranged over a very wide field. Nearly one hundred and forty separate contributions dealing with various aspects of the refrigeration industry were brought up for discussion, and have occupied the attention of seven sections at morning and afternoon sessions on three days. To-day's final session is a general meeting for recording and passing resolutions embodying the results of the week's work.

On the engineering and scientific sides papers have been presented dealing with original researches in progress in various countries; with the evolution of refrigerating plant and machinery afloat and ashore; with the design and construction of ships for the transport of frozen meat and produce; and with the application of refrigeration to the needs of the brewing industry, dairy products, to the manufacture of rubber products, and to the ventilation of mines. Main interest has, however, been concentrated on the part played by refrigeration in providing meat supplies to the population of Great Britain and Ireland.

TRADE IN FROZEN PRODUCE.

This point was emphasised by Mr. Sidney Webb, President of the Board of Trade, in opening the Congress. There had, he said, been great centres of population before London and the densely inhabited industrial areas of Great Britain, but the older human concentrations had not been composed of meat eaters, and the maintenance of food supplies had been a far less difficult task than in the modern era. Only by practical applications of the science of refrigeration had it been possible for the desired standard of living in Great Britain to be maintained. This view of the situation was reflected in many of the papers submitted, and it was shown that, given further aid by engineers and scientists and the necessary capital, very important developments are in prospect.

Before dealing with the engineering aspects it will be of interest to indicate the character of the trade which has grown up in refrigerated produce since meat was first shipped to England from the United States in 1874 with natural ice and salt as a preservative. The pioneer cargo of meat cooled by mechanical refrigeration was sent from Australia in about 1879. Since that period figures submitted to the Congress by Sir Henry Rew showed that imports of chilled and frozen beef have increased from 36,918 tons to 514,293 tons a year, and of frozen mutton and lamb from 15,492 to 286,305 tons. In 1923 the imports of chilled and frozen meat into Great Britain and Ireland totalled 925,000 tons and represented 80 per cent. of the output of the world's freezing works. Twenty years ago home meat supplies amounted to nearly two-thirds of the meat consumption of the kingdom. Last year the proportion was only about 53 per cent.

To meet the requirements of this traffic it has been necessary to make constant additions to the insulated capacity for frozen foodstuffs, and Lloyd's Register statistics, it was shown in figures submitted to the Congress, revealed an increase from 68,251,000 cubic feet in 1914 to 99,000,000 cubic feet at the end of last year. An interesting account of the cold storage facilities provided at the principal ports of Great Britain was given by Sir Joseph Broodbank. Omitting many of the smaller provincial stores, there were now, he said, 38,322,000 cubic feet of accommodation. London possessed over 15,000,000 cubic feet, Liverpool 8,000,000 cubic feet, Manchester 3,555,000 cubic feet, and Glasgow 2,500,000 cubic feet. Comment was made on the fact that with the exception of the cold stores at the ports of London, Glasgow and Bristol it had been private rather than public enterprise which had taken the risk of large capital commitments. Sir Joseph's contribution contained technical descriptions of some of the newer plants. Other aspects of this subject were raised by Mr. T. A. Peace, the engineer of the Bristol dock system, who described methods of insulating reinforced concrete cold store construction, and by Mr. G. P. Stevenson, who described a special type of cold storage door with a self-closing vestibule air lock.

INFLUENCE ON SHIP DESIGN.

The special methods used in the construction of ships and refrigerating appliances for vessels employed

on long voyages were described by Mr. A. R. T. Woods, a recognised authority on the subject. He discussed the need in the case of vessels built for the chilled meat trade of heavier deck scantlings for hanging cargoes, the most economical heights for decks and holds, and also dealt with the important subject of air circulation. Methods of insulation were described, including a recent system of using slab cork and the new cellular expanded rubber compound, which is very light and has a low thermal value. Modern refrigerating plant on the cold air battery system and the cold brine system were dealt with. The reasons for the preference now given to the brine pipe system were explained and the relative advantages of the two arrangements of this system—open circuit and closed circuit—discussed. The claims of the closed circuit design which makes the chief appeal to a superintending marine engineer are, Mr. Woods explained, that it enabled brine tanks to be dispensed with, saving valuable space, while there was little chance of air being taken into the system. Reference was also made to the vigilance in connection with marine refrigerating plants of the surveyors of Lloyd's Register of Shipping.

A whole group of papers was devoted to the subject of refrigerating machines. One contribution, made by Messrs. Escher, Wyss and Co., who were among the first to specialise in carbonic acid compression machines, dealt with that type of plant, with the design of ammonia compressors, with plan of the two-stage type compressors, and with the "autofrigor" small power refrigerating machines. The story of the evolution of the ammonia compressor was also told in a contribution from Messrs. Sulzer Frères. It was claimed that the general tendency to increase the speed of rotation had satisfactory results in diminishing size and reducing costs. It had, it was shown, been necessary to solve certain problems of construction to attain higher speeds, and this work had, it was claimed, a good effect, not only on conditions of working, but had improved the safety of operation. The use of high-revolution compressors for marine refrigeration was stated by Mr. E. Markham to be analogous to the employment of the high-revolution steam engine in the benefits it conferred.

In a detailed account of the development of the two-stage ammonia compressor in the United States, Mr. N. H. Hiller commented on the high cost of this type of equipment owing to the fitting of water intercoolers, liquid coolers and ammonia injection or intercooling to secure higher capacity and a saving in the power used. There was now, he said, a large number of machines of this type in operation—sixty-five Carbondale-Worthington two-stage compressors were in the list—and as this type of machine was seldom applied to compressors of less than 75 tons capacity the aggregate tonnage of these machines was a large figure. Mr. Henry Brier, who contributed an account of pre-cooling by primary evaporation and multiple effect compression as applied to CO_2 refrigerating machines, quoted the results of trials and experiments to show the gain in refrigeration due to the conversion to multiple effect compression when working with circulating water at temperatures between 60 deg. and 90 deg. Fah., and with brine at zero Fah. and the percentage gains and economy in power. Mr. Truman Hibbard traced the development of the synchronous motor for driving ammonia compressors and for the air compressors and pumps used in refrigeration plants.

New types of refrigerating cycles was the subject of a paper by Professor Ostertag. He showed that recent methods of production of cold by evaporation were all based on improvements in the dry system. Variants which tended to augment the productive capacity were the suppression of the superheating of the cold gas in the suction piping, the use of compound compression, removal of heat at intermediary stages during compression, pre-cooling by cold gas or liquid refrigerant, and condensation in several stages.

Insulating materials were discussed in a number of papers. The review of the subject given by Sir Richard Glazebrook and Dr. Ezer Griffiths was an interesting survey of the work carried out for the Engineering Committee of the Food Investigation Board. Dr. Glazebrook, who presented the report to one of the largest sectional audiences, dealt with apparatus for the measurement of thermal conductivity, properties of the materials used, including moisture absorbing capacity, porosity to gases, radiation and convection from the wall surface and transmission of heat through an insulated wall.

STANDARDISATION OF EQUIPMENT.

The question of the standardisation of refrigerating machines and unification of methods of measuring refrigerating capacity was raised by Mr. G. W. Daniels, who said that the standard rating conditions had been under discussion for a number of years, the most important proposals having emanated from the Refrigerating Research Committee of the Institution of Mechanical Engineers. This plan specified both temperatures and temperature ranges, while a proposal, with which Professor Marchis's name was associated, specified the regulating valve temperature. It was suggested that the Congress should carefully consider the report of the Committee of the Institution of Mechanical Engineers with a view to the adoption of the standard rating conditions laid down therein, with perhaps the addition of the regulating valve temperature. The same subject was referred to by Mr. W. H. Medcalf, who said that there certainly was room for a standard unit of capacity in refrigeration. Something more than a commercial rating was required, and the only satisfactory guarantee possible should be one based on duty actually performed under conditions specified by the buyer of the plant.

The place of refrigeration in the educational equipment of the marine engineer is an interesting topic, but it was shown by Mr. H. A. Garratt, as the result of inquiries he has made, that very little interest has been taken in the subject by education authorities, even in shipping districts. At the present time, shipowners and others engaged in the refrigeration industry had, it was stated, to rely for their supply of expert engineers for this class of service on the training given by practical experience at sea. In defence of the education authorities, it was made clear that no demand had been made upon them for special courses in refrigeration, but that if such a demand were put forward it would receive sympathetic treatment. Mr. Daniels referred in detail to the Department of Refrigeration in the University of Liverpool, and urged that an appeal should be made to the industry for financial support for educational centres dealing with refrigeration. He also suggested the setting up of a permanent advisory committee to form a link between the industry and the universities.

The use of refrigeration in other directions than the preservation of food was dealt with in a number of contributions to the literature of the Congress. Messrs. F. A. Willcox and J. D. Farmer described the use of refrigeration in the ventilation of mines. They illustrated their case by reference to the St. John Del Rey Mine, in the State of Minas, Brazil, which is the deepest mine in the world, it having been found possible by the utilisation of refrigeration to work at depths of 6700ft.

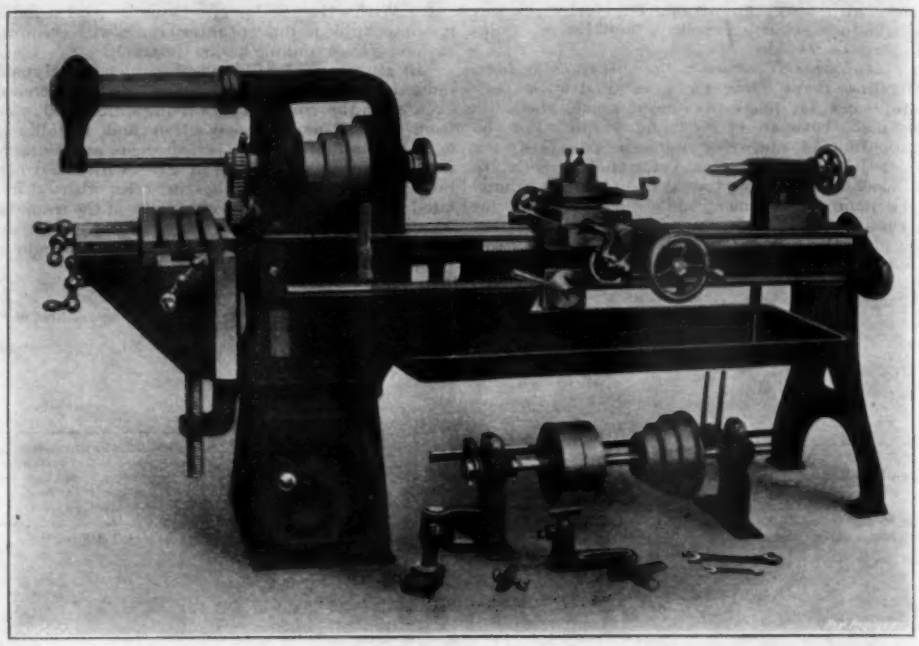
An account was given through J. and E. Hall, Limited, of the employment made of refrigeration in the manufacture of rubber products. The particular case considered was that of the manufacture of cables for electrical work, in which difficulty was experienced during the summer months, owing to the rubber blocks from which the insulating material was cut becoming soft and tacky. It was decided to employ refrigeration to reduce the temperature as a substitute for the less effective and more inconvenient method of cooling by ice. The plant gave satisfactory results. Refrigeration had also been, it was shown, applied with success to the de-waxing of lubricants and in the electrolysis of liquids.

The visits of inspection included in the programme for this week have been to the London Central Markets cold storage, the cold air stores at Hay's Wharf, the works of J. and E. Hall, Limited, Dartford, and the National Physical Laboratory, which is being visited to-day. On Monday next a tour of inspection to the cold storage plant and part of the dock system of the Port of London will be made, and an alternative visit has been arranged to the cold storage plant at Avonmouth Dock. On Tuesday the premises of the International Cold Storage and Ice Factory at Southampton will be inspected, and other visits, mainly for the inspection of cold storage and handling plant, will be made to the ports of Manchester and Liverpool. The Congress will terminate on this day week with a visit to Cambridge.

A banquet, which was attended by over 300 delegates and guests, was held on Tuesday evening at the Hotel Cecil, under the chairmanship of Sir Gordon H. Campbell, K.B.E., the president of the Congress. After the loyal toasts the chairman gave the toast of "The Refrigerating Congress Movement," which was responded to in excellent English by Monsieur André Lebon, the president of the Institut Internationale du Froid. The health of "The Visitors" was proposed by the Right Hon. Lord Kylsant, G.C.M.G., and replied to by Mr. Frank A. Horne, of the United States of America. Mr. R. H. Cabell proposed the toast of "The Chairman," who, in replying, suggested that really it was the health of those who had actually done the hard work in connection with the Congress, and proposed that the health of "The Secretary" should be drunk, a suggestion which met with a very hearty response.

COMBINED LATHE AND MILLING MACHINE

SCOTT BROTHERS, KEIGHLEY, ENGINEERS



A Combined Lathe and Milling Machine.

IN the machine illustrated by the engraving above, Scott Brothers, of Albion Works, Keighley, have combined in a very handy form the qualities of a back geared lathe and a plain milling machine. It is intended for small works and general engineering workshops, where the outlay on two separate machines would not be warranted and where it is unlikely that the two classes of work would be in hand at the same time, although it would be easily possible to use the lathe and the milling machine simultaneously if required.

The lathe part of the machine has centres 6¼in. high with a bed 6ft. long, and will take pieces 40in. long between the centres. There is also a gap in the bed which increases the swing at the face plate to 26in. It will thus be seen that the machine will accommodate fairly substantial pieces of work.

The slide rest, tailstock, &c., are of normal design, but the arrangement of the lead screw is peculiar. As it was inconvenient to accommodate the change wheels and quadrant plate in the usual manner, at the headstock end, the driving gear is arranged at the right-hand end of the bed, and is worked by the back shaft. There is a reversing gear on the back end of the mandrel, which drives a three-speed gear box through an intermediate wheel. The back shaft is connected with the gear-box at one end, and at the other drives the lead screw through a set of change wheels. The gear box has three ratios of 1 to 1, 1 to 2, and 2 to 1, while by changing the intermediate wheel a reduction in the ratio of 2½ to 1 can be obtained, so the gears give a wide range of speeds for surfacing and sliding, and also allow several pitches of screws to be cut without altering the change wheels.

The milling machine, it will be seen, uses the back end of the lathe mandrel for driving the cutters. The mandrel is bored through with a $1^{3}/_{16}$in. hole, but the arbors for the milling cutters are not held by an extension running through the mandrel, as that would preclude the use of the lathe, for centre work, at the same time as the mill. This difficulty has been overcome by cutting a thread on the back end of the mandrel and tapering the bore. The arbors are provided with a shoulder, and are drawn into the taper by a screwed sleeve. In order to take up thrust on the mandrel in either direction, ball washers are fitted at both ends.

The arrangement of the remaining parts of the machine is so obvious in the engraving that it needs no explanation, except to mention that the milling table has the unusually long traverse of 30in., a very useful feature in milling long splines or in sawing work. The rise and fall of the table is 10in. while the travel is also 10in. The weight of the machine is approximately 15 cwt.

Railway Matters.

THE contract has been let by the British Colombia Electric Railway Company for the 3400ft. tunnel, which is to connect Aloutte and Stave lakes and increase the hydro-electric development, both at the mouth of the tunnel and at the present Stave Falls plant.

SATISFACTORY progress is being made with the electrification of the South-Eastern section of the Southern Railway. The steel work at four of the power stations is being erected, and the foundations are under construction at ten. Fifty-six miles of track have been bonded.

IN this column on May 16th it was reported that an investigation was to be held as to the railways of New Zealand. We now hear that Sir Sam Fay and Sir Vincent Raven will proceed thither when they have concluded their inquiry into the New South Wales railways mentioned in our Journal page on January 4th last.

AN inquiry was addressed to the President of the Board of Trade on the 27th ultimo as to the £5,500,000 guaranteed to the Southern Railway under the Trade Facilities Act. The Minister of Transport replied that up to the present tenders had been called for and contracts placed at various dates for approximately £2,000,000 altogether. All were for the electrification of the South-Eastern section of the Southern Railway.

THE annual report of the Canadian National Railways, presented to the House of Commons on May 28th, showed a total deficit for 1923, including fixed charges, of 52,779,350 dollars. The corresponding figure for 1922 was 58,896,911 dollars. The gross operating revenue was 263,554,436 dollars, as compared with 241,685,651 dollars for 1922, and the gross operating expenses 242,366,973 dollars, as against 237,692,414 dollars for 1922.

THE railway statistics for the month of March last, compiled by the Ministry of Transport and recently issued as a Stationery Office publication, explain that the passenger traffic figures were affected for the better by the tramway and omnibus strike in London. A larger number—5.6 per cent. more—of passengers were carried in March, 1924, than in March, 1923, but the receipts fell by 13.3 per cent. But it is gratifying to see that the increase in passenger train mileage was only 2.9 per cent.

THE freight traffic returns in the Ministry of Transport railway statistics for March are not satisfactory. The tonnage, when compared with the corresponding period of 1923, showed a decrease of 0.7 per cent. Because of the reductions in rates made in May and August, 1923, the receipts were proportionately worse, and yet the companies carried more traffic than at any time since the keeping of statistics was begun in January, 1920. The ton-miles for the month were over 1689 millions, and the train-miles showed an increase of 5.3 per cent., but the train-miles per engine hour fell from 3.39 to 3.23 and, consequently, the ton-miles per engine hour from 466 to 443¼.

ON June 10th General H.R.H. Prince Purachatra, Director of the Siamese State Railways, visited Marconi House and instructed the Relay Automatic Telephone Company, Limited, to despatch to Siam some of its new loud-speaking telephones and other apparatus to work in connection with the "Relay" automatic telephone exchanges which are at present serving the Siamese State Railways. His Royal Highness expressed his pleasure at the service the "Relay" exchanges were giving in his country. This is one of the first overseas cases of the application of the new loud-speaking telephones to automatic telephony, which has been developed by the Relay Company, of Marconi House. Several are already working on installations in England.

REPRESENTATIVES of the Associated Society of Locomotive Engineers and Firemen met the general managers on the 12th inst. as to modifying the award of the National Wages Board last December. Variation was asked for in respect to the classification of the men and as to the minimum payment for Sunday duty. Mr. Bromley, the secretary, intimated that, failing consent, a ballot would be taken as to a strike. The general managers replied that they were not prepared to agree to what was asked for, but were willing to inquire into various matters of detail that had been mentioned. It was expected that, as threatened, a ballot would follow, but the Associated Society now says that it will wait and see what the companies do in the matters of detail mentioned.

THE question of a suitable port for the export of Rhodesia's agricultural and mineral products was debated in the Legislative Assembly at Salisbury on June 12th. A motion was adopted urging the Government to consider the early construction of a railway connecting Rhodesia with Walvis Bey, and particularly to make a preliminary survey to secure the necessary information. The mover of the motion declared that such a railway would enable cattle to be exported on the hoof to Europe and coal to be marketed in South America. Colonel Birney, the general manager of the Rhodesian Railways, said that the question of the export of cattle was probably the most important factor in support of the proposed line. The Premier, Sir Charles Coghlan, said that the Government was willing to make the inquiry asked for.

THE railway companies explain that award No. 728 of the Industrial Court has been accepted by, and is now in operation on, all railways except the Great Northern and Great Central sections. On an Order of the Industrial Court, the award does not become operative until March 1st next. It is indicative of the benefits given to the men by the award that some of the excepted shopmen struck work because the London and North-Eastern would not put the award into operation forthwith. It must be remembered, too, that railway shopmen still have 10s. 6d. bonus out of the original 26s. 6d., whereas the shopmen in non-railway works enjoy only 10s. As with the enginemen so with the shopmen; any change would be a variation of an award given by a court in which there were not only representatives of labour but of the public.

Notes and Memoranda.

THE investigations of the platinum-bearing lands in the neighbourhood of the Cabo de Gata, in Spain, are being continued, and very interesting results are said to have been obtained from the analysis of samples of ore obtained.

ACCORDING to laboratory experiments of Professors Grube and Burkhardt in Stuttgart, it is possible through the use of chromium-plated cathodes to obtain pure solutions of hypochlorite and chlorate electrolytically, without the addition of substances to prevent reduction.

THE Secretary for Mines announces that the electric storage battery competition, which closed on April 30th, attracted ten entries, all of which were from British manufacturers. The preliminary consideration of the designs has now been completed, and five vehicles have been selected for test under working conditions upon an experimental track which is to be constructed for the purpose.

AN article in the *Wireless World and Radio Review* describes a tuned cathode circuit. The tuned anode system of coupling high-frequency thermionic valves is, of course, well known, but the tuned cathode method seems to be quite a new idea. The author claims, among other things, that the tuned cathode enables several stages of high-frequency amplification to be employed without any tendency for the circuit to oscillate.

A NOVEL experiment in milk transport will shortly be undertaken by the United Dairies, Limited, by which milk will be conveyed to the distribution centres straight from the country in large glass-lined tank motors, instead of by rail. These tanks have a capacity of 1250 gallons. It is claimed for the tank wagons that they involve less rise in temperature in the milk in transit, less labour in loading and unloading, and greater ease in cleaning.

ACCORDING to the *Electrical World*, a research paper was presented at the recent Cleveland meeting of the American Society of Mechanical Engineers. It involved the detailed analysis of every stress and vibration that occurs in turbine-disc wheels under all conditions of temperature and pressure. Mr. Wilfred Campbell, who presented it, showed how the problem was solved to its last detail and how quantitative results were obtained that could be applied to all similar applications in all industries.

WIRELESS beam tests made by Senatore Marconi from Poldhu to Buenos Aires are claimed to have been eminently successful. The first message transmitted was from Senor Le Breton, Minister of Agriculture of the Argentine Republic, who is at present in London, to General Justo, Minister of War, Buenos Aires. This is the first message which has been transmitteed to the Argentine by the beam system, and, according to telegraphic advice, the message was received practically instantaneously in Buenos Aires upon a single transmission.

FROM a statement made in Parliament on behalf of the Ministry of Labour it appears that the working days lost through industrial disputes in Great Britain and Northern Ireland in 1919, 1920, 1921, 1922, and 1923 numbered, approximately, 35 millions, 26½ millions, 86 millions, 20 millions, and 10¼ millions respectively. For the months of January and February, 1924, the corresponding figure was over 1,300,000. The foregoing figures relate only to days lost at the establishments where the disputes occurred, and no figures are available as to days lost at other establishments. Disputes involving less than ten workpeople, and those lasting less than one day, are not included in these figures, unless the aggregate duration—*i.e.*, the number of workpeople involved multiplied by the number of working days—exceeds 100 days.

IT is not generally known that the Commonwealth has large deposits of radium-bearing ore, and that this precious substance has actually been extracted in Australia. The deposits occur in two places, both of which are in the north of South Australia. The first is at Olary, which is not far from Broken Hill, and the second at Mount Painter, about 200 miles further north, on the Oodnadatta railway line. Radium was discovered at Olary as far back as 1906, the radio-active ore being carnotite, or uranyl potassium vanadate. Carnotite is a greenish-yellow ore. In 1911 rich radio-active ores were discovered at Mount Painter. The Olary field is well developed, five shafts having been sunk to a depth of 150ft. Many thousands of tons of ore are now awaiting treatment there. The carnotite ore also contains rare earths, and they also will be extracted. These deposits are said to be the only known fields in the world in which the ore occurs in the form of a lode.

CONSIDERABLE quantities of tin cans are brought to the destructor at Birmingham, states the *Iron and Coal Trades Review*. The amount of tin is small, but its removal presents no difficulty, and the remaining metal base thereby acquires an enhanced value. The process of de-tinning which was devised at Birmingham is an electro-chemical one, and needs only one man for its operation. The cans are first passed through a toothed crushing machine, which serves the dual purpose of reducing their bulk and perforating them, so that at a later stage the electrolyte easily percolates. From the crushing machine the cans fall into a cage situated in a well about 4ft. deep. When full, the cage is raised by a travelling electric hoist and taken into a room where there are two electrolyte vats, each capable of holding five cages. Between each pair of cages and at both ends of the vat copper plates hung in the electrolyte, form the cathodes, the corresponding anodes being the tin cans. The current enters the cans *vid* a plate in the bottom of each cage, passes through the electrolyte, which consists of a solution of caustic soda and stannous chloride, and on leaving *vid* the cathode deposits the tin on the latter. Each cage holds about 150 lb. of cans, and takes about 20 minutes to de-tin. The working temperature is 80 deg. Cent.; a current of 500 ampères at a pressure of 5 or 6 volts is used, and the treatment involves about 25 kilowatt-hours per ton of cans. After washing the cans are finally pressed into bales weighing about 1 cwt. The tin is occasionally scraped off the cathodes; it consists of a grey powder containing 77 per cent. pure tin, and is sold in this form.

Miscellanea.

IT is stated that contracts for the erection of the new electric generating station for the Cape Town-Simonstown line, costing a million sterling, will be placed early in July.

THE Brazilian Government has authorised the extension of the port quays, both at Rio de Janeiro and Pernambuco. It is hoped that the serious losses that have been incurred by British steamers owing to the congestion alongside of these and other piers will soon become a thing of the past.

AT a meeting held in the Town Hall, Halifax, on June 7th, it was decided to found a Yorkshire Branch of the Institution of Structural Engineers. The meeting was addressed by the president of the Institution, Major James Petrie, who explained at some length the aims and activities of the Institution, and the benefits accruing to members of a branch. The acting local secretary is Mr. D. Lloyd Jones, of Halifax.

DEVELOPMENT of power on the Ottawa River which is contemplated by the Ontario Hydro-electric Power Commission, was announced recently by Premier Howard Ferguson, of Ontario. About 700,000 horse-power will be developed and the Hydro Commission has made application to the Ontario Government for certain water leases. The sites asked for are on the Ottawa River between Ottawa and Pembroke, being principally Chads Falls, Du Ford Falls, Des Joachims Falls, and Alumette Falls.

THE Commercial Counsellor to the British Embassy at Paris reports that, according to the *Sans Fil*, three automobile services will be operated on the initiative of Monsieur Citron in October next between the Sudan and the Niger, on the one hand, and Algeria on the other. The most important of these services will be the one which will connect the cotton-growing country with the Niger. Starting from Colomb-Béchar, it will run *viâ* the Saoura Plain and Thouat to the Sudan at Tabankor and the Niger at Tourengue-Gao-Niamé, the centre of the operations of the Société Cotonnière du Niger.

IT is reported by the National Federation of Iron and Steel Manufacturers, that the production of pig iron in May amounted to 650,900 tons, compared with 618,400 tons in April and 714,200 tons in May, 1923. The number of furnaces in blast at the end of the month was 191, a reduction of 3 since the beginning of the month. The production includes 194,900 tons of hematite, 239,300 tons of basic, 148,800 tons of foundry, and 37,400 tons of forge pig iron. The output of steel ingots and castings in May amounted to 809,700 tons, compared with 711,500 tons in April—when production was affected by the Easter holidays—and 821,000 tons in May, 1923.

ACCORDING to the *Faraday House Journal* the Tecnomasio Italiano Brown Boveri Company, of Milan, has received orders for two 30,000 kilovolt-ampère three-phase alternators. These machines, which are the most powerful yet constructed in Europe, are intended for the Mese hydro-electric station near Chiavenna on the Liro. They belong to the Sta. Idroelettrica Cisalpina, of Milan. They generate 8000 volts, run at a speed of 500 revolutions per minute, and have a frequency of 50. The machines are totally enclosed, and require 45 cubic metres of air per second. The total weight of each alternator with its exciter is about 120 tons.

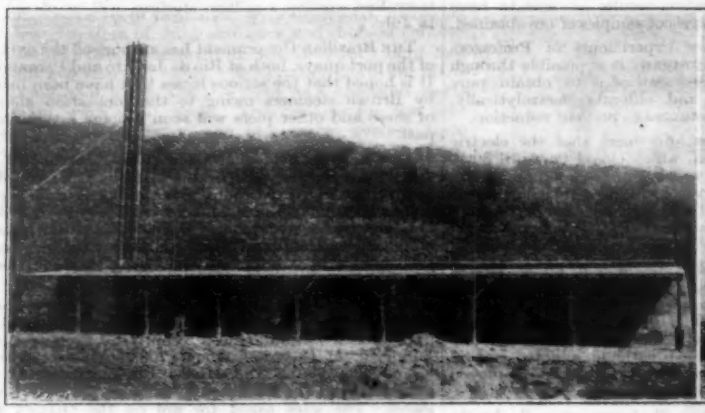
IT is authoritatively announced in the *South African Mining and Engineering Journal* that the Durban Town Council, subject to one or two minor points, has now arrived at an understanding with the Electricity Supply Commission regarding the new power station it is proposed to erect at Congella. This new power station is necessary in connection with the electrification of the railway between Durban and Maritzburg. No difficulty will, it is expected, be experienced in reaching a final agreement on the details still outstanding. The Electricity Supply Commission has thus come to terms with both the Durban and Capetown municipalities, which will ensure an abundant supply of electricity for these towns without their going to the expense of erecting new power stations. Johannesburg's Town Council is now alone in asserting its independence of the Commission.

THE second International Foundry Trades' Exhibition was opened by Mr. R. O. Patterson, President of the Institution of British Foundrymen, at the Bingley Hall, Birmingham, yesterday, the 19th inst., and remains open till the 28th. It was unfortunately in a very incomplete state on the occasion of the Press view, and very few of the stands were ready for investigation. A series of lectures has been arranged in connection with the Exhibition, and includes:—"A Comment upon the Methods of Judging and Mixing Pig Iron," by Mr. Horace J. Young, June 25th, 7.30 p.m.; "Economy in Foundry Practice," by Mr. E. Harwood Brown, June 26th, at 7.30 p.m.; "The Problem of the Liquid Contraction of Grey Cast Iron," by Mr. Robert Buchanan, Past-president of the Institute of British Foundrymen, June 26th, 3 p.m.; "Porosity in Cast Iron," by Mr. Arthur Marks, June 27th, 3 p.m.; and "Experimental Study of Different Systems of Ramming Sand," by Monsieur E. Ronceray.

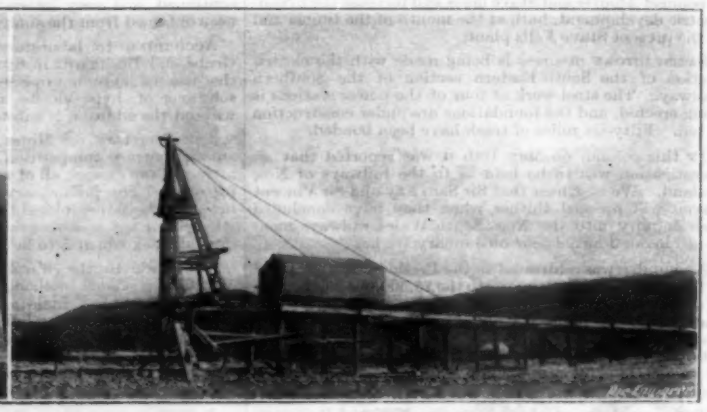
AN electric steam generator, installed in the Hudson Falls, N.Y., plant of the Union Bag-and Paper Company, was described in a recent issue of *Power*. This plant is devoted to the manufacture of paper, paper bags and other paper products, and the new steam generator will furnish steam for heating purposes and process work. The boiler was built by the General Electric Company. It is rated at 5000 kilowatts, 6600 volts. It was designed to generate steam at 100 lb. pressure, and it will, it is stated, evaporate over 16,000 lb. of water per hour. It operates in parallel with fuel-fired boilers, but its working is mostly confined to periods of high water and non-working days, when an excess of water is available. The generator is in the same room as the fuel-fired boiler and takes up a floor space of approximately 0ft. by 10ft., with a 24ft. headroom for the pump, shell and primary switchboard panel. The unit is operated by the same staff which works the fuel-fired boilers, no increase in boiler-room force being necessary.

BLAST FURNACE PLANT AT ONAKAKA, NEW ZEALAND

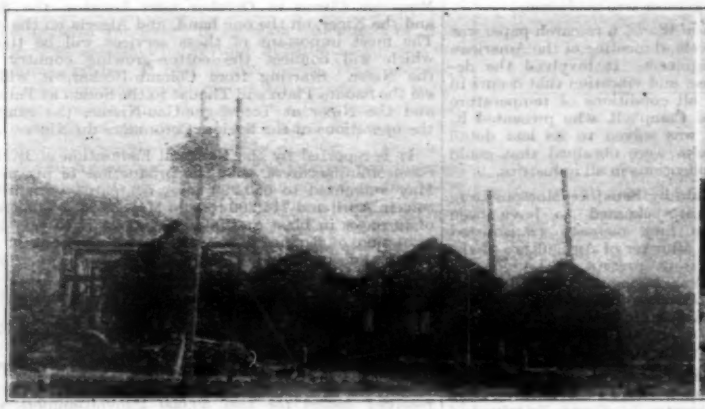
(*For description see page* 690.)

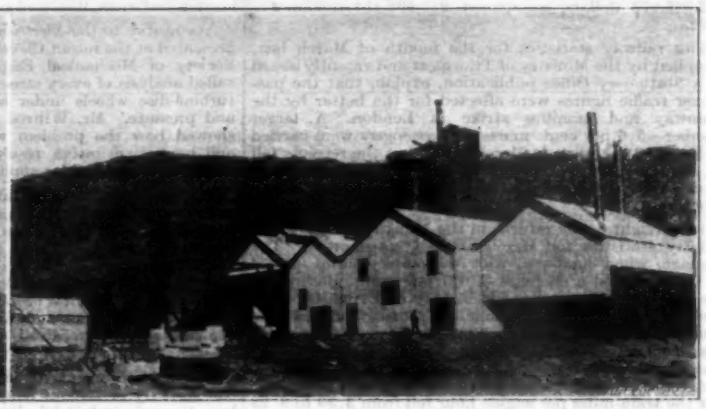


BEEHIVE COKE OVENS



WHARF UNDER CONSTRUCTION





VIEWS OF THE BLAST FURNACE

IRON ORE QUARRY

GENERAL VIEW OF THE WORKS

TAPPING THE FURNACE

RUNNING OFF SLAG

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The Engineer

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THE ENGINEER can be had, by order, from any newsagent in town or country, at the various railway stations; or it can, if preferred, be supplied direct from this office.

Half-yearly (including index number) .. £1 12s. 6d.
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DEATH.

On the 14th inst., at Lawnside, Newport, Mon., ARTHUR JAMES STEVENS, J.P., M.I. Mech. E., director, Usksides Engineering Company, Limited, in his 82nd year.

THE ENGINEER.

JUNE 20, 1924.

Economy versus Efficiency.

AMONGST the papers read at the recent spring meetings of the American Society of Engineers, one that attracted exceptional attention dealt with the Value of Efficiency in Transforming and Distributing Energy. The author was Mr. Charles E. Lucke, Professor of Mechanical Engineering in Columbia University, who is well known as an acute observer of all movements, both scientific and economic, in the field of studies he has selected as his own. Time out of mind it has been common knowledge that efficiency and economy are not interchangeable terms. Engineers have discovered over and over again that efficiency may be bought too dearly, and that if a wide instead of a narrow and specialised view be taken of problems which arise from time to time it is found that the means which science suggests as those that should be followed in the search for improvement are not those which satisfy the dictates of economy. Hence the scientific engineer has to face many disappointments, and has often to see his cherished hopes of introducing more scientific methods overthrown by an accountant who knows nothing of science or of engineering, but does know, by the testimony of figures, that "efficiency" does not always pay. The accountant is, after all, bitter as it is to admit it, in the right; for, outside the laboratory where everything is permissible, the engineer is under an obligation to reduce the total cost of whatever he may be called upon to produce. It is not sufficient that he should present a better way of doing something, that he should be able to show an attractive scientific progression in the method he proposes, or that he should be in a position to convince his brother scientists and engineers that his plan is better than an existing plan. If he cannot prove to the satisfaction of the accounts department that, when all is said and done, the adoption of his proposal will result in an appreciable reduction of the price at which the product may be sold, or an increase in the profit that may be realised, then his plans will be, and ought to be, rejected. The only exception to this rule is when an expensive plan is adopted, because there are good grounds for believing that in the long run it will lead to real economies.

Whilst, as we have said, the kind of facts which we have just outlined are familiar to engineers, there has hitherto been no effort to make a scientific study of the relationship between efficiency and economy. That task is generally left with the accountants, and their decision, backed up by the directors and shareholders, is final. Professor Lucke has endeavoured to bring the matter to a better plane in respect of a single but extremely important branch of engineering—the transformation and distribution of energy, or, more briefly, power supply. The problem is one of great complexity, but it resolves itself into the discovery of a measure by which we may distinguish the best from the worst and grade all others between those two limits. Assuming that such a measure may be found it "must be simple and easy to apply if it is to be useful, and it must be complete and conclusive to be acceptable." To find that measure or basis is the problem which Professor Lucke set himself. He observes that there are two main issues—"suitability" and "cost." Where suitability is not in question then "cost" is decisive, and the real difficulty arises when a lower standard of suitability corresponds with lesser costs. We shall return to this point again. For the moment let us note that Professor Lucke takes for the first step in his process "costs in terms of certs per million B.Th.U.," at any point and in any form. We do not propose to follow his argument from start to finish, but we print below an abstract from his paper which shows the general formula he derives for the estimation of real economy or commercial efficiency. Generally it is necessary to investigate costs by means of minute segregations of separate processes, and for that purpose tests are necessary, but "in all such cases the commercial efficiency determination must be made for the whole series, inclusive of all the interchanging effects," and, adds Professor Lucke in italics, "*When this is done, it will be found that many so-called economies which are so easily demonstrated thermally by manipulation of steam tables and thermo-dynamical relations, are not economies at all, but are additional expenses.*" Let us now consider for one moment a question connected with suitability and lesser cost, which we fear will always defy the mathematician. Under the heading of costs the accountant must include capital expenditure. Now, it rarely happens that a reformed method is less costly than an established method; it is usually far more expensive because the plant and organisation for the production of the equipment exists only on a small scale if it exists at all, and because if the existing method is supported by a powerful corporation business pressure in one form or another may be brought to bear to prevent the adoption of the reformed method. Hence to succeed the latter must be in a position to exhibit economies much greater than those that would satisfy the user of an existing method. In other words, it has not only to show an improved economy but it has to show an improved economy sufficient to outweigh the additional capital expenditure. If the matter were left to accountancy alone progress against such odds would be very slow. It is here that capital performs one of its most useful functions, for it makes daring ventures into the uneconomical, sometimes with success, sometimes with failure, and sometimes only to be swamped or absorbed by greater capital which desires to remove its competition. We fear this is an item that can never be included in a formula. The commercial man is more devoted to business efficiency than to thermal efficiency, and will deliberately oppose the latter if he sees a probability that it will interfere with the former.

Through this hurly-burly of conflicting interests the path of the engineer is clear. Whilst he admits that economy and efficiency may be different things, it is his obvious duty to work with all his might for increased efficiency. He must ever feel it a disgrace that no more than 20 to 30 per cent. of the heat units in fuel are turned into useful work, and ever maintain a determination to reduce that disgrace at every step. Success may not come in his day; but come it will if the principles on which he is working are sound. Years and years ago superheating was tested and discarded because the upkeep costs ran away with the thermal advantages; to-day it is common practice. Loftus Perkins advocated very high pressures sixty years ago, but was beaten by the materials at his command and by prejudice. To-day we are advancing towards such pressures as he used. So it will always be. For the time being the

engineer may have to sacrifice efficiency because the cost of purchasing it is too great, but in the course of time means will be found of overcoming all difficulties and of doing what he has known to be right. It is his duty to keep on striving for higher and higher efficiency; it is the accountant's duty to reject efficiency till it can be had with economy.

Disruptive Adventures.

AFTER causing considerable inconvenience to the travelling public of London for more than a week, the strike of power-house men and uniformed staff on the Underground Railways came to a sudden conclusion on Saturday last. It is quite unnecessary to deal with its details, for from the beginning to end it was irregular in every respect. Presuming that the men were sincere in their aims, and that their demands were not advanced merely as a cloak for Communism, they should, clearly, have put them in the hands of the trades unions. It is serious enough, in all conscience, to have frequent strikes conducted by orthodox methods on orthodox lines by recognised trades unions, but if we are to be faced with irresponsible strikes at the dictates of a few self-constituted leaders, industry will become impossible. There are those who take the sinister view that that is the object of irregular strikes, and of the late strike in particular, and some grounds to support that hypothesis are not lacking. The cynical indifference to public convenience was just what might have been rationally expected from men whose object it was to overthrow the constitution of society, and the fact that the strike came to an immediate end at the first decided step taken by the companies affected and by the National Union of Railwaymen suggests the possibility that the outbreak was deliberately engineered to run for a certain period of time and that it was brought to an end when that period had elapsed. But if that be, indeed, the case, it is difficult to understand the attitude of certain trades unions which lent their countenance to the revolt. They, at least, should have known better than to assist in any way a group of men whose action would inevitably weaken the power of the authorised unions.

The combinations of workmen into trades unions have resulted in much harm to industry, and much, rather problematical, good to workpeople. But they have received the sanction of Governments and the recognition of employers because they provide a ready means for collective bargaining and for the settlement of questions connected with the organisations of factories and industries. Employers feel that, on the whole, it is better to deal with recognised leaders and administrators than to have to face strike committees or strike leaders selected *ad hoc* at the will of the workpeople. Were it not for this quality of trades unions, the manifest advantages of the open shop would outweigh all other considerations, and the trades unions would not be recognised and would not enjoy the exceptional exemption from the common law which an indiscreet Government gave them in the Trades Disputes Act. Up to exactly one hundred years ago combinations of workmen were illegal. By two Acts, one of 1824 and the other of 1825, that disability was removed, and the right of collective bargaining, involving the power to withhold labour by concerted action, was established by the law of the land. Those Acts were passed because it was felt to be better that above-board unions should exist than that secret and illegal societies should brew troubles underground and give rein to the "rattening," which was the only effective weapon the workpeople could employ. It would appear that the workpeople themselves are now showing a tendency to go back to the very things that it was the purpose of Parliament to remove by the repeal of the Combination Act of 1799–1800, for though the strikers in the recent outbreak happened to be members of trades unions, they were not acting under the instructions of their unions, and were therefore in a sense a secret society—that is to say, not one known openly to the employers. Moreover, there is something painfully akin in the method of their strike and rattening, for whilst there was no actual breaking of machinery or cutting of belts, they effected injury to the public and to industry more costly than the destruction of much mechanical plant. It is an interesting question for lawyers if such a combination is in itself not illegal, and if the leaders could not be proceeded against by common law, despite the fact that, by returning to work, they eluded the plain ground of action that was constituted by their abstention from work without due notice. That, however, is a point with which we are now little concerned. The important issue is that such "disruptive adventures," as Mr. Clynes aptly called them, must in the long run undermine the unions by removing the advantages of collective bargaining.

Practically the whole of the machinery for the settlement or prevention of trades disputes is based on the premise that responsible and representative organisations of workpeople and employers exist. It would be impossible to reach any conclusion to disputes in the absence of federations and unions. But, equally, it will be impossible to carry out any agreement if the unions cannot be relied upon to act in a corporate capacity, and if at the will of a handful of disaffected men agreements may be set at nought and the machinery for the settlement of industrial questions rendered nugatory. If such a practice is tolerated, the principle of collective bargaining for which the trades unions have laboured assiduously for a hundred years will be destroyed, and we shall return to the conditions that prevailed prior to 1824. Neither the unions nor the country can tolerate such a possibility. If the unions desire to continue in the enjoyment of the privilege conferred upon them by the Act of 1825 and of subsequent Acts, particularly the Trades Disputes Act of 1906, they must take steps to suppress once and for all every revolt against their authority. No other alternative is conceivable, for any other must lead to that very condition of chaos from which it has been the purpose of all legislation on industrial disputes to deliver us. The Government refused in the recent strike to take any action at all, but we cannot imagine that the public will tolerate again such inconvenience as it has recently suffered without showing, whatever Government may then be in power, that it requires of it a clear indication of its intention to crush revolts which must in the end utterly destroy all chance of the establishment of peace in industry.

The Efficiency of Power Supply.*

THE common sources of primary energy are fuels—coal, oil and gas in the earth and water at an elevation. To get a correct picture of the whole process, the energy costs in cents per million B.T.U. must be evaluated and periodically checked from source to point of consumption, and at every point between where there is transportation, transmission or transformation. The more completely this is done, the more clearly it will appear just where costs have accumulated most and where, as a consequence, it is most worth while to exert effort to reduce costs. It will also appear that in this train of successive cost accumulations, other things being equal, the earlier in the train a saving is effected, the greater the ultimate effect at the end of the train, especially when the cost accumulation is the result of inefficiency or actual energy losses rather than high investments or operating disbursements. Exactly the same system and with the same units, when brought down to individual stages of a process, will clearly show the value of efficiency or energy losses, investments and operating disbursements to control the losses in effecting either transformation of energy from one form to another or its transmission in any one form.

It is a principle generally applicable to every such process step that a cost at any one point in the train of transmission and transformation from mine, well or waterfall to the point of consumption is the cost of all the operations plus the original cost of energy at the starting point.

Each operation or process step adds three cost increments, namely—

(*a*) An increment due to loss of energy;
(*b*) An increment due to equipment investment; and
(*c*) An increment due to operating disbursements.

For a single operation starting at point A and ending at point B, the costs are formulated as follows:—

Costs in cents per million B.T.U. at B (B) = cost at A (A), plus inefficiency increment (x A), plus investment increment (I), plus operating disbursement increment (O), or—

$$B = A + x\,A + I + O.$$

If E = efficiency from A to B = ratio of output to input energy, then—

$$A + x\,A = \frac{A}{E} \text{ and } x = \frac{1 - E}{E}$$

Therefore the inefficiency increment of cost is (1 − E) A/E and the total cost increments for the process are—

$$B - A = \left(\frac{1 - E}{E}\right) A + I + O$$

This leads to two expressions for the cost per million B.T.U. at the end in terms of cost at the beginning, the efficiency of the process, and the expenses for investment and operation. These are—

$$B = \frac{A}{E} + I + O$$

$$= A + \left(\frac{I - E}{E}\right) A + I + O$$

With this formulation, it now becomes possible to establish a measure of *commercial efficiency*, E_c, for the process with an algebraic relation to its energy efficiency E. Defining commercial efficiency as the ratio of cost of input energy to cost of output energy, each in cents per million B.T.U., then—

$$E_c = \frac{A}{\frac{A}{E} + I + O}$$

$$= \frac{A\,E}{A + E\,(I + O)}$$

$$= \frac{E}{I + E\left(\frac{I + O}{A}\right)}$$

Interpreting this expression, the commercial efficiency is equal to the process efficiency, divided by 1 plus the product of process efficiency and the ratio of process expenses to original cost. As the denominator is always greater than unity, the commercial efficiency will always be less than the process efficiency.

A numerical example will make these relations more clear. Assume energy of fuel costing 32 cents per million B.T.U. to be transferred to energy of steam available for a turbine with an overall process efficiency of 60 per cent., and requiring an investment that adds 30 cents per million B.T.U. output, with operating disbursement adding 25 cents more.

Then the inefficiency increment of cost will be—

$$\left(\frac{1 - E}{E}\right) A = \left(\frac{1.0 - 0.6}{0.6}\right) \times 32 = 21.33 \text{ cents}$$

$$B = A + \left(\frac{1 - E}{E}\right) A + I + O = 32 + 21.33 + 30 + 25 = 108.33$$

or—

$$B = \frac{A}{E} + I + O = \frac{32}{0.6} + 30 + 25 = 53.33 + 30 + 25 = 108.33$$

and—

$$E_c = \frac{A}{B} = \frac{32}{108.33} = 29.5 \text{ per cent.}$$

$$= \frac{E}{1 + E\left(\frac{I + O}{A}\right)} = \frac{0.6}{1 + 0.6\left(\frac{55}{32}\right)} = 29.5 \text{ per cent.}$$

For this case, an energy efficiency of 60 per cent. yields a commercial efficiency of only 29½ per cent.

This method of judging process is applicable to a series of processes constituting a system of transforming or of transmitting energy in any form. It is of special value in appraising alternatives for single processes or systems where efficiencies of processes or systems may vary considerably with equipment investment and operating disbursement expenses. It shows directly the value of efficiency in terms of all prime variables through the approach to equality of commercial efficiency and process efficiency. That process efficiency or system efficiency is most valuable whose commercial efficiency is most nearly equal to its own value, and of course when both are as high as possible.

* From a paper by Prof. Lucke. See leading article above.

A Blast Furnace in New Zealand.

THE following particulars of a blast-furnace plant which has recently been put into operation in New Zealand have just reached us. The position of the plant is at Onakaka, which is in the Collinwood District in the extreme north of the South Island, about 82 miles north-west of Nelson. In the immediate neighbourhood of the works there are extensive deposits, said to run into hundreds of millions of tons, of limonite iron ore, as well as limestone suitable for fluxing purposes, while good coking coal is obtainable within economic distance. The blast-furnace, which has been installed by the Onakaka Iron and Steel Company, has a productive capacity of 30 tons of pig iron every twenty-four hours.

The iron ore deposits, which contain just the necessary percentage of iron and silica for successful smelting, and the limestone lie close together at an elevation of some 1000ft. above the blast-furnace, and supplies of both are taken to the latter by means of an overhead ropeway by gravity alone. The ropeway is designed to carry 8 tons per hour, and the distance through which the materials have to be transported is about 1¾ miles. At the summit of the ropeway there are covered store sheds, to which the ore is brought from the quarry by means of a light railway. At the furnace site the ore and limestone are delivered to a crusher, the discharge from which passes over screens into storage bins. Ore, limestone and fuel are weighed from these bins, and raised by hydraulic lift to the charging platform of the furnace. The ore and limestone bins have a capacity of 1000 tons.

The blast-furnace has a hearth 5ft. in diameter and

a height of 62ft. from hearth to charging platform. The motive power of the smelting works consists of three steam engines, one of 120, one of 90 and one of 25 horse-power respectively, steam being supplied by one Babcock and Wilcox and one multitubular boilers, both of which are fired by waste gases from the furnace. There are also in the engine-room a 17½-kilowatt dynamo and a blower having a capacity of 1000 cubic feet of air per minute, which the hot stove can raise to a temperature of 1000 deg. Coke is prepared on the site in sixteen beehive ovens, which are designed to produce 30 tons in twenty-four hours. There are coke bins capable of storing 200 tons. The moulding floor is of sufficient area to accommodate 30 tons of pigs. The slag from the furnace is run off into a shoot, where water is played on it, so as to granulate it and to sluice it down a launder over the face of a hill into a gully, where it is stored.

No information is forthcoming as to the iron content of the ore, which is only described as being of "fine grade," but we are enabled to give below the analysis of the metal which was produced during a trial smelting, at which the Government Chief Inspector of Mines was present. This analysis was made at the Government laboratory :—

ORE STORAGE SHEDS

Graphitic carbon	2.89
Compound carbon	0.19
Silicon	3.92
Sulphur	0.04
Phosphorus	0.22
Manganese	0.64

The Inspector in his report referred to the metal as being grey in colour, of the required softness and a marketable product. He added that at each tapping better and better metal was being obtained, and that the results appeared to be satisfactory. It is reported that the ironfounders of the Dominion who have used the metal pronounce it as being "equal to the best Scotch pig iron." It is stated, too, that even with this single furnace, pig can be turned out "far more cheaply than it can be imported."

It is said to be the intention of the company to add to its plant a basic hearth furnace, so that steel may be produced by the continuous process. It is also proposed to manufacture cast iron pipes, for which there is a heavy demand in the Dominion. At the present time there is being erected at the water front near the furnace a wharf or jetty with storage bins and mechanical equipment, so that steamers may unload and load at the rate of 200 tons per hour. In the first instance, the wharf is to be 1210ft. long, which will take it sufficiently far from the shore to provide a depth of 10ft. of water at low water of spring tides. That is the maximum depth required by the largest vessels at present trading in the neighbourhood, but should direct export of the iron and steel become necessary, the wharf can be extended far enough to give a depth of about 23ft. at low water of spring tides.

Views of various parts of the works, the iron quarry and the wharf are given on page 688, while a view looking over the ore storage sheds in the direction of the blast-furnace, 1¼ mile away and 1000ft. lower down, is given herewith, the position of the smelting works being indicated by the cross.

Literature.

Mechanical Refrigeration : A Practical Study of Cold Storage and Ice-making in all their Aspects. By HAL WILLIAMS. Revised edition. London : Sir Isaac Pitman and Sons, Limited. 1924. Price 20s. net.

THE original edition of this book was published in 1903, and, having regard to the considerable strides made in the science and practice of cold storage during the intervening period, it is not surprising to find that the present volume has had to be very largely rewritten. It is true that certain portions remain very much as they were in the first edition, but they deal with such matters as "General Principles" and "History," in which there has been no change. On the other hand, we find much that has been entirely replaced by new matter, and still more that has been very considerably extended, with the result that what is practically a new work, brought right up to date, has been produced. The expansion and alteration have been so great, in fact, that the book has been increased in size by very nearly 50 per cent.

The volume is divided into an Introduction and fourteen chapters, the first three of which deal with (*a*) the laws of fluids, heat, liquids, gases and vapours ; (*b*) thermodynamics ; and (*c*) historical matters. Chapter IV. is devoted to the properties of ammonia, carbonic anhydride and other refrigerants ; and Chapter V. to types of machines. Then follow chapters dealing with "The Refrigerating Plant ;" "Auxiliary Plant ;" "Insulation ;" "Brine ;" and "Ice-making." It would be impossible to indicate every instance in which alterations and additions have been made in these chapters so as to adapt their contents to present-day practice, but on going through and comparing the two editions, we have continually found evidence of the thoroughness with which the author has reviewed his former work, and modified it to suit existing conditions. Sometimes, the modification has taken the form of entire deletion, as in the case of the chapter on "Distilled Water," which found a place in the original volume, and the substitution for it, in another place, of a section dealing with means for expelling air from the water so as to obtain clear ice—one of the objects aimed at in using distilled water. More often, however, we find that the process of treatment employed has been amplification, which has been rendered necessary by the development of processes and the increase of knowledge which have resulted from the efflux of time.

Of this amplification, there is abundant evidence in the last four chapters in the book :—"Cold Storage," "Articles in Cold Storage," "Other Applications," and "The Design of Abattoirs, Freezing and Meat Packing Works." The last twenty years have seen advances in all directions in the applications of refrigeration, and the author has apportioned a large part of his space—practically a third of the entire book—to their consideration. Probably there have been no greater developments than in the carriage of fruit from the Antipodes to this country, and much is said as to the best methods of treatment to employ, both before and during the long sea voyage. Fruits are not, of course, the only thing dealt with, much interesting information regarding the refrigeration of meat, eggs, butter, &c., being given. The final chapter on the equipment of modern abattoirs and freezing houses—about which comparatively few people in this country know anything—should prove particularly valuable.

Low-temperature Carbonisation. By C. H. LANDER, D.Sc., M.I. Mech. E., and R. F. MCKAY, M.Sc., M.I. Mech. E. Ernest Benn, Limited, London. Quarto. 275 pages with 47 Tables and 53 Illustrations. Price 35s. net.

THIS is another of the handsomely produced and well printed volumes upon scientific and technical subjects which the firm of Ernest Benn, Limited, is now bringing out in rapid succession. Mr. C. H. Lander is Director of Fuel Research under the Department of Scientific and Industrial Research at the Experimental Station erected in 1918–19 at East Greenwich, and Mr. McKay is an assistant in the same station. Sir George Beilby, at whose instigation the present work was undertaken, contributes a foreword to the volume, and states that Messrs. Lander and McKay were specially well qualified to write a book on the subject of "Low-temperature Carbonisation," because they were associated closely with the experimental work carried out at East Greenwich during the last six years, and especially because they were quite free from any interest in the commercial development of the various processes examined.

Messrs. Lander and McKay state in their preface that although it cannot be claimed that the difficult problems of the low-temperature process, involving both scientific and economic considerations, have been completely solved, yet considerable progress has been made, and in Chapter XIX. they give special consideration to the economic aspects of the problem, and present some tentative balance sheets for the various processes. They have been able to make use of the material and data contained in the official publications of the department, which embrace not only the experimental work carried out at H.M. Research Station at East Greenwich, but also the work and results obtained by inventors and research workers all over the world.

The book is divided into nineteen chapters, which deal with the subject under the following headings : —I., Introductory : An Initial Survey ; II., The Aims of Low-temperature Carbonisation ; III., The Fuel Problem ; IV., Notes on the Constitution of Coal ; V., The Classification and Testing of Coal ; VI., Notes on the Chemistry of Carbonisation Products ; VII., The Effect of Heat upon Coal ; VIII., Technical Problems : Methods of Heating the Material ; IX., Technical Problems : The Effects of Steam and Gaseous Pressure on Coals Carbonised at Low-Temperatures ; X., Other Technical Problems ; XI., The Products of Low-temperature Carbonisation : Coke ; XII., The Products of Low-temperature Carbonisation : Gas ; XIII., The Products of Low-temperature Carbonisation : Tar ; XIV., The Products of Low-temperature Carbonisation : Motor Spirit ; XV., Nitrogenous Products from Coal ; XVI., Processes : Early Work ; XVII., Processes : Some Later Developments ; XVIII., A Discussion of some Difficulties Encountered in Low-temperature Carbonisation ; XIX., The Economics of Low-temperature Carbonisation.

It is impossible in the limits of space afforded by this short review to discuss the contents of these chapters in detail, but it may be said that the last four, Nos. 16–19, will be found the most interesting and instructive by the chemists and engineer engaged more especially in the practical development of the low-temperature process of coal carbonisation. Chapter XIX., on the Economic Aspects of the subject, contains a summary of the authors' conclusions, and from it we make the following quotation :— "If the various assumptions regarding capital cost and the prices obtainable for by-products are substantially correct, and if the technical difficulties of the process can be successfully overcome, it will be seen that the commercial success of a plant will be mainly dependent on the ratio which the price commanded by the coke bears to the cost of the raw coal. If it can be sold at a price only equivalent, weight for weight, with that of the raw coal, the prospect of establishing an industry commensurate with our national requirements is by no means promising. On the other hand, if the raw material can be obtained at a price such that the coke will approach in value the whole cost of the coal used, there would appear to be a sufficient margin for commercial success. This, however, can only be definitely settled when an industrial plant has been running continuously for a considerable period, the products being marketed at a fair price and a reasonable profit to the shareholders."

Both authors and publishers may be congratulated on this book, which ought to be purchased and read by all interested in low-temperature carbonisation, whether from the economic or hygienic standpoints. It is unfortunate, however, that the work has appeared about the same time as that of Messrs. Wellington and Cooper, on the same subject—see THE ENGINEER, April 25th, for review of the latter—and that the titles of the two books are identical, since some confusion is likely to result. We can only suggest that our readers may solve the difficulty by purchasing both books, and reading them as complementary one to the other.

BOOKS RECEIVED.

Der Eisenhochbau. By C. Kersten. Berlin : Wilhelm Ernst and Sohn, Wilhelmstrasse 90.

The Law as to C.I.F. Contracts. By H. Goitein. London : Effingham, Wilson, 16, Copthall-avenue, E.C. 2. Price 4s. net.

Factory Costing. By H. H. Emsley. London : Constable and Co., Limited, 10–12, Orange-street, W.C. 2. Price 7s. net.

The Journal of the Royal Agricultural Society of England. Volume 84. London : John Murray, Albemarle-street, W. 1. Price 15s. net.

The Journal of the Municipal College of Technology, Manchester. Volume XI. Published by the Education Committee, Manchester.

Annales des Travaux Publics de Belgique. Tome XXV., 2e Fascicule—Avril, 1924. Brussels : Goemaere, Imprimeur du Roi, Rue de la Limite, 21.

The Specific Heats of Gases. By J. R. Partington and W. G. Shilling. London : Ernest Benn, Limited, 8, Bouverie-street, E.C. 4. Price 30s. net.

Small Houses for the Community. By C. H. James and F. R. Yerbury. London : Crosby Lockwood and Son, Stationers' Hall-court, E.C. 4. Price 31s. 6d. net.

Motor and Carriage Painting. By A. Bates. London : The Trade Papers Publishing Company, Limited, Bank Chambers, 329, High Holborn, W.C. 1. Price 6s. net.

The Elements of Railroad Engineering. By William G. Raymond. London : Chapman and Hall, Limited, 11, Henrietta-street, Covent Garden, W.C. 2. Price 22s. 6d. net.

Annales des Ponts et Chaussées. (a) Fasc II., Tome I., Partie Technique, 1924—II., Mars-Avril ; (b) Fasc II., Partie Administrative, 1924—II., Mars-Avril. Paris : A. Dumas, 6, Rue de la Chaussée d'Antin.

The Lancashire and Cheshire Coal Research Association. The Inorganic Constituents of Coal. Part IV., The Melting Point of Coal Ash. By F. S. Sinnatt, N. Simpkin, and A. B. Owles. London : H. F. and G. Witherby, 326, High Holborn, W.C. 1. Price 2s. net.

The Pipe Lines of the Moncenisio Hydro-electric Plant.

By S. L. R. HOLLIS, A.M.I. Mech. E., A.M.I.E.E.

THE greatly increasing demand for hydro-electric power can be attributed to its cheapness and convenience, and, even in cases where it cannot be supplied at a lower rate than steam power, economy of operation and greater flexibility frequently determine its use. But considerable development can also be directly traced in certain countries, notably Switzerland and Italy, to the inauguration of a national policy to be economically independent of outside supplies of coal by utilising, under State control, water-power resources to provide energy chiefly for the purpose of extensive electrification of railways. Switzerland will have the distinction, no doubt, of being the first country to dispense entirely with the steam locomotive in favour of the electric, and the Italian Government has also expressed itself in favour of the electrification of its complete railway system.

Not only do certain economic factors impel the use of hydro-electric power and the opportunity serve to develop widely scattered water-power sites, but it is possible to bring under review and study exceptional features, and to develop characteristics which can be said to be peculiar to the water-power resources of both these countries. The majority of water-power installations in Switzerland and Italy utilise a comparatively small flow of water at a high head, and the engineers of those countries, conjointly with certain firms familiar with the exigencies, and specialising in the design and manufacture of the necessary plant, have perfected and successfully operated this class of installation to a point at which it has been possible to develop high heads on a scale never previously undertaken, and which is likely to remain unchallenged for some considerable time. The honours for the highest operating head in the world rest with a comparatively small Swiss plant. The next to rival it is the recently completed Moncenisio hydro-electric plant, which operates under the highest head developed upon an extensive scale in the world.

It is for these reasons that it is thought that a brief survey may be of both interest and practical value with regard to certain essential factors concerning the pipe lines recently put into operation, together with details of the exacting and novel nature of the official tests demanded by the Italian Government in connection with the Moncenisio hydro-electric plant, which is owned by the Società delle Forze Idrauliche del Moncenisio, Turin.

GENERAL PARTICULARS.

As a general description of the plant may also be of interest and serve perhaps in some measure to indicate the significance of the details which follow, it may be mentioned that the site is about 40 miles west of Turin, and is situated on the river Cenischia immediately above its junction with the river Dora Riparia. Profile drawing—Fig. 1—shows a general view of the undertaking. The reservoir shown on this drawing at level 6301ft. is formed by three dams, the largest of which has a height of 69ft., and a length of 605ft. It has a storage capacity of 1160 million cubic feet. From this reservoir the water passes through an older plant owned by the same company, and is then taken to the intake tunnel, at level 5638ft., of the new plant. This intake tunnel is circular with a cross sectional area of 310 square feet, and it has a length of 5750 yards. It is lined throughout its entire length, partly with reinforced concrete of thicknesses varying between 8in. and 20in., the remainder being lined with steel plate.

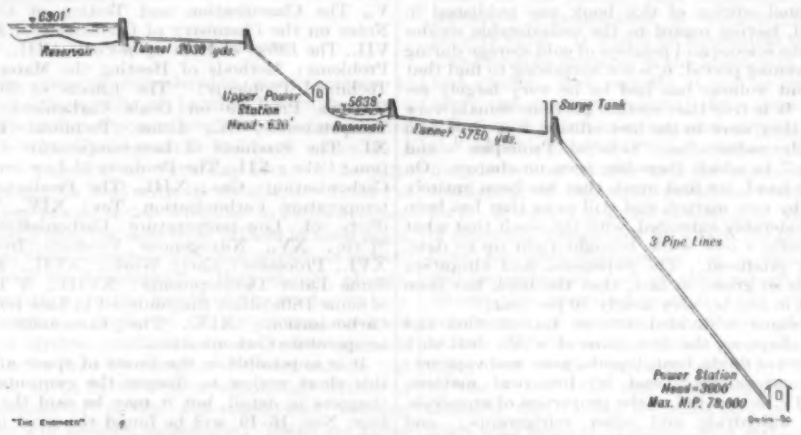


FIG. 1—PROFILE OF THE MONCENISIO HYDRO-ELECTRIC PLANT

The following table shows the main characteristics of the pipe lines between the surge tank and the power house :—

Head in feet	3600
Length in feet	7700
Internal diameters	39½in., 35½in., 30½in., 27in., 23½in.
Weight of each pipe line, tons	1097
Number of pipe lines	Three

The graduated diameters of pipe lines Nos. I and II. and of the lower 1800ft. section of pipe line No. III., are distributed as shown in Fig. 2.

Pipe lines Nos. I., II. and III.—with the exception of the upper section of pipe line No. II., which is of Italian manufacture—were designed, manufactured and erected by "Ferrum," the London office of which is Perrin's, Limited, engineers, 15, Catherine-street, London, W.C. 2. This figure also shows a general arrangement of the pipe lines as well as the types of joints employed, &c.

MATERIALS AND STRESSES.

The calculations for plate thicknesses of the plain lap-welded pipes employed in the upper part of the lines and of the "Ferrum" patented reinforced pipes were based upon assumed stresses on the full plate given in the following table, which also shows the figure used for calculating all cast steel specials and distributing pipes at the power house :—

	Lb. per sq. in.
Plain lap-welded pipes	10,650
Ferrum reinforced pipes	12,100
Cast steel specials and distributing pipes	6,400

The material employed in the manufacture of the pipes is high-grade Siemens-Martin open-hearth steel of the following physical properties :—Tensile strength, 48,500/58,000 lb. per square inch ; minimum elongation, 25 per cent. Plain lapwelded pipes are used down to a point at which the calculated plate thickness exceeds 28 mm., and below that reinforced pipes are employed.

The reinforced pipe consists of a core pipe, manufactured in exactly the same manner as a plain lap-welded pipe, over which are shrunk, at required intervals, seamless reinforcing rings made from steel of a tensile strength of 64,000/85,000 lb. per square inch with a minimum elongation of 18 per cent. The construction of a reinforced pipe can be seen by reference to Fig. 3.

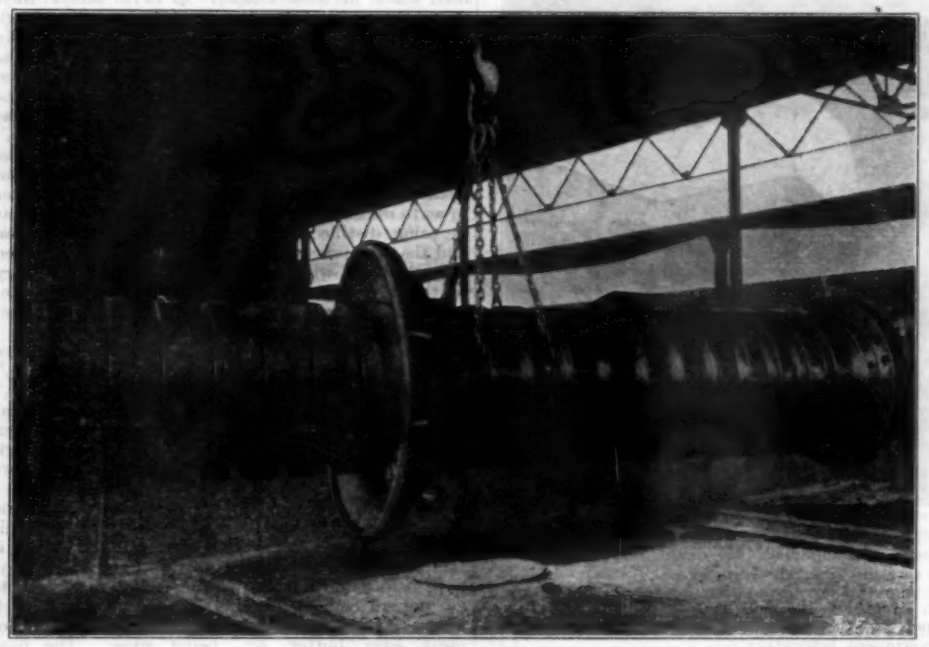


FIG. 3—REINFORCED "FERRUM" PIPE

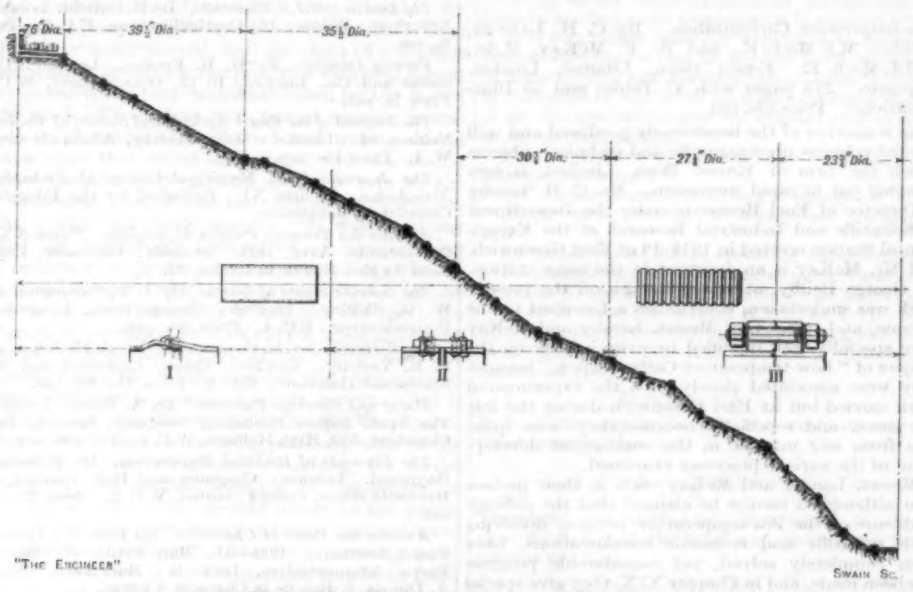


FIG. 2—LAY-OUT AND DETAILS OF PIPE LINES

JOINTS.

The pipes were manufactured in lengths of 20ft. and, up to a plate thickness of .95in., they were fitted with riveted bump joints. For greater plate thicknesses, except at the lower sections of the pipe line, a riveted band joint was employed. At the lower end a patented screw flange joint, with rubber packing, is used. See I., II. and III., Fig. 2.

LAY-OUT OF PLANT.

At the power house the three pipe lines are connected up by means of distributing pipes to three turbine units, each of which is designed to give a normal output of 22,000 horse-power, with a maximum of 26,000 horse-power, calculated for a net head of 3400ft. at a speed of 500 revolutions per minute. Each turbine is coupled direct to a 3-phase generator of 21,200 k.V.A. The generated pressure is 6500 volts, which is transformed to 75,000 volts for transmission. The turbines were manufactured by the Riva Company of Italy, and are of the ordinary Pelton wheel type, with deflector regulation, each unit being fitted with four bearings.

COST OF PIPE LINE.

The contract price of the pipe line installation at the time it was supplied was approximately 3,000,000 lire ex-works, that figure also including charges for the experienced engineers detailed to supervise the entire work of erection, but excluding labour and supply of the necessary tackle. For the purpose of clarifying in some measure the question of costs regarding the pipe lines, it may be stated that, in addition to the cost of transport from the works to the site the Italian customs authorities imposed a tariff on the pipes of 1800 lire per ton, which

was equivalent to a duty of about 90 per cent. on the total cost.

TESTS OF PIPE LINE.

The erection of pipe lines I. and II. was started in February, 1922, and completed by November of the same year. All the pipes were tested before despatch from the works to a pressure of 50 per cent. in excess of the actual static pressure to which they would be subject in service. Moreover, in accordance with the regulations laid down by the Italian authorities, each section had to be separately tested after erection. Reference to Fig. 4 shows the exacted pressure tests represented in diagrammatic form, all of which were satisfactorily attained. The sections in question were isolated by means of strong cast steel covers fitted on the ends of pipes determining the sections under test. For the purpose of conducting tests by this method, each pipe line was divided into seven sections from bend 37 to 32, 37 to 27, 37 to 24, 37 to 19, 37 to 15, 37 to 11, 37 to 5 respectively.

In each section there were fitted three manometers which gave readings shown diagrammatically on Fig. 4, as follows:—Dial No. I., on left-hand side, shows the maximum manometer reading at point 37 during the test for the section between bend 37 and the point on the pipe line to which the dial is shown adjacent. Dial No. II., in centre, shows the maximum pressure applied during the pressure test, below the cover at the point to which the dial refers. Dial No. III., on right-hand side, shows the pressure applied above the cover fixed at the point to which the dial refers; this pressure was applied in order to reduce the stress on the anchorage blocks during the tests.

For the sake of clearness a figure is placed above each dial to indicate at which point of the pipe line any particular manometer reading is taken. It will be seen from the diagram that the pressure test on the lowest section registers a maximum of 5400ft. head, that is to say, 50 per cent. above the pressure due to the actual difference in levels.

The pressures required to be applied during the tests were obtained by connecting to the pipe line a force pump with a capacity of 265 gallons per minute driven by a 60 horse-power electric motor.

The cast steel covers fitted between the sections were provided with by-pass pipes and valves for the purpose of filling and drawing off the water. The internal diameter of these valves was $1^1/_{16}$in. The covers between the sections of the pipe lines were fitted immediately below the anchorage blocks and between the inner pipe of the expansion joint and the pipe next above it. In consequence, when pressure was applied during the test to the section below the cover, the latter, in turn, transmitted the resultant thrust to the anchorage block. It was, therefore, necessary, when calculating the dimensions of the anchorage blocks, to take this additional thrust into consideration, and the pipes passing through the anchorage blocks were also provided with anchorage rings specially designed to take up this upward thrust.

The figures given in Fig. 4 refer to pipe lines Nos. I. and II. only as, at the time the results were tabulated and analysed, pipe line No. III. was still in course of erection. It can, however, be stated that pipe line No. III. was, later, tested in exactly the same manner, and has recently been put into service after satisfactorily meeting all the requirements. Pipe line No. I. was proved under test to be perfectly tight, but a few of the joints on pipe line No. II. required minor adjustments before being passed for service.

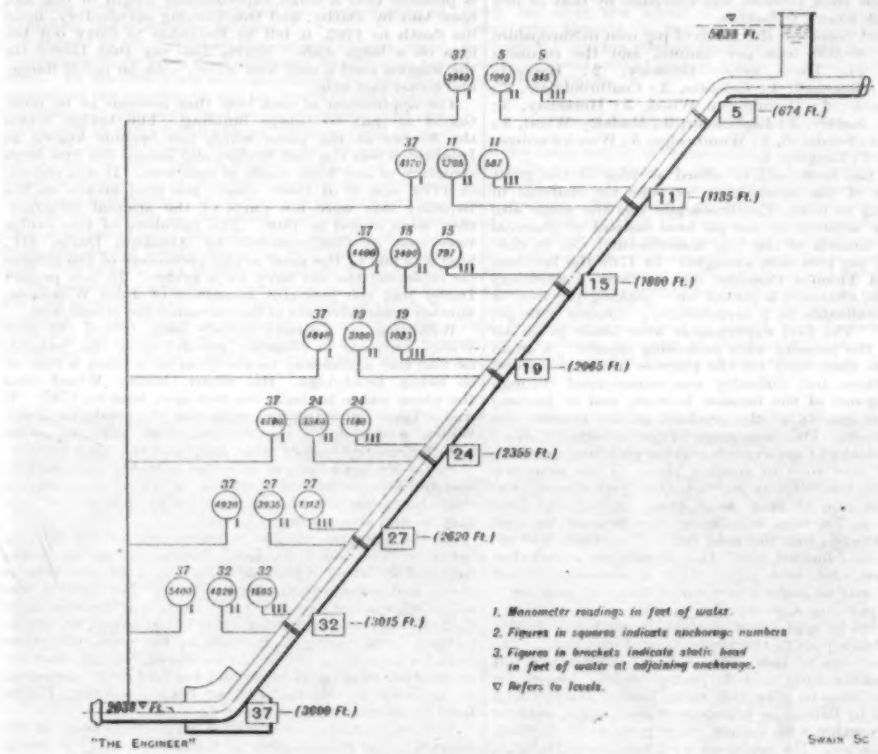

5633 Ft.
5 (674 Ft.)
11 (1135 Ft.)
15 (1800 Ft.)
19 (2065 Ft.)
24 (2355 Ft.)
27 (2620 Ft.)
32 (3015 Ft.)
37 (3099 Ft.)
2038 Ft.
1. Manometer readings in feet of water.
2. Figures in squares indicate anchorage numbers.
3. Figures in brackets indicate static head in feet of water at adjoining anchorage.
▽ Refers to levels.
"THE ENGINEER"
SWAIN Sc

FIG. 4—DIAGRAM OF PIPE LINE PRESSURE TESTS

JOINTING.

It may possibly be instructive to note, with regard to the upper section of pipe line No. II., that the packing groove, wherever flanges are employed, is arranged in such a way that the jointing material must be inserted from inside the pipe. This method proved unsatisfactory as, although the operation of renewal can be said to be a comparatively easy matter, considerable trouble was experienced in keeping the packing tight on account of the fact that the design requires initially that the water pressure exerted from inside shall force the rubber packing into its correct position in the groove. It was found that that movement was not automatically effected and, consequently, the packings of all these joints had to be adjusted a number of times before they could be passed as satisfactorily water-tight. The opinion was, therefore, formed that the uses of this method of packing were practically limited to their employment as a safety or reserve packing in conjunction with the arrangement shown at III. in Fig. 2, and then only when the flanges are embedded in concrete. Even in that case, however, it is thought to be superfluous, as the packing arrangement referred to can be relied upon to give efficient service.

As, however, the system shown at III., Fig. 2, might be objected to on the ground that, in the case of flanges embedded in concrete, there is no possibility of effecting renewals, it can be stated that a close scrutiny of records and experience with this type of joint shows that, while it has been extensively used for high-pressure service in connection with water-power pipe lines for fifteen years, especially in Switzerland, in no single instance has it been so far necessary to effect any replacements. The

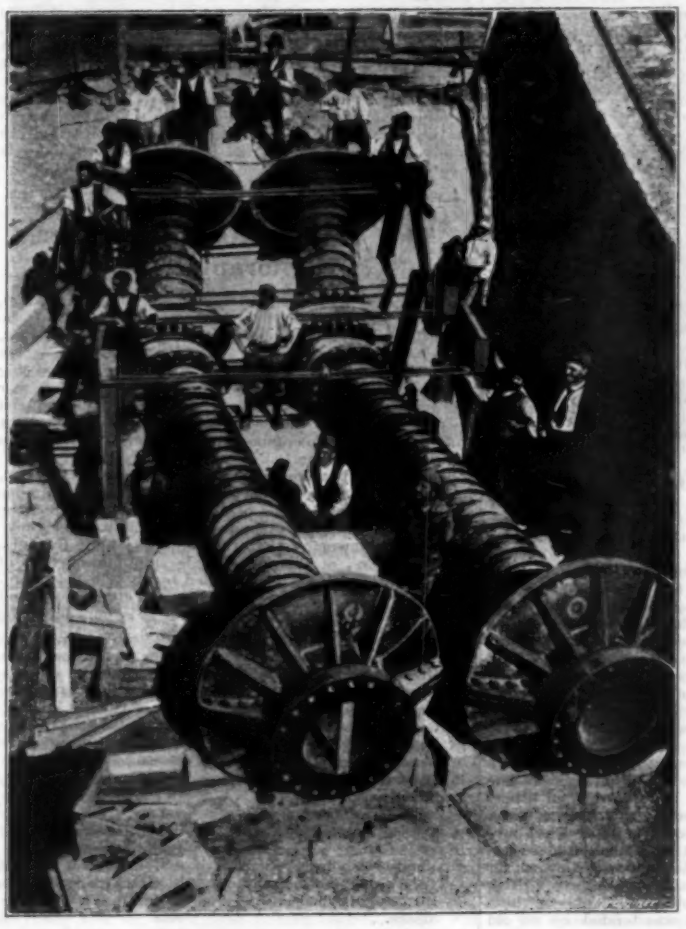


FIG. 5—CONCRETING BENDS AT LOWER END

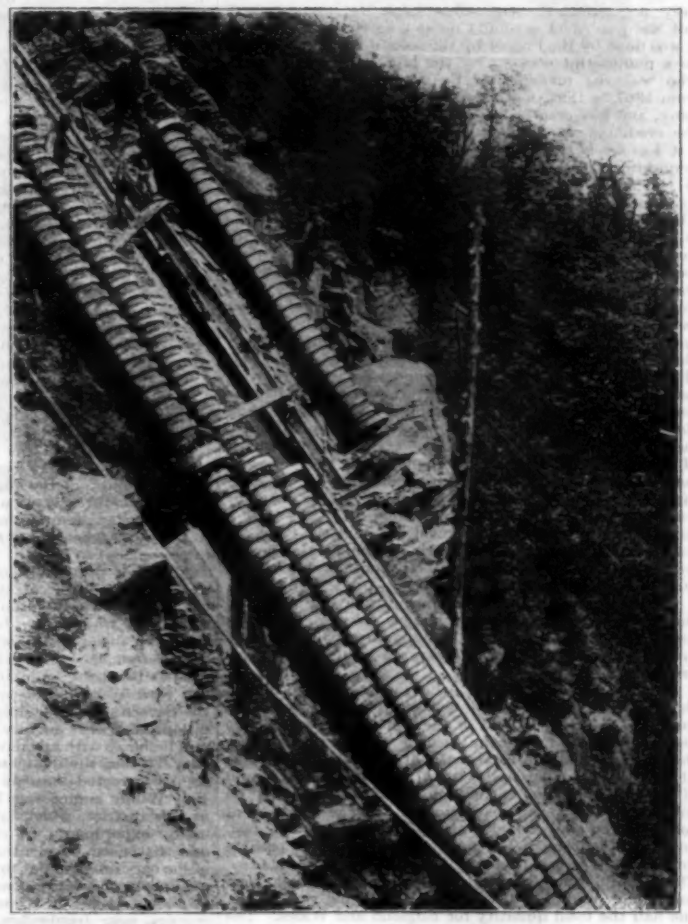


FIG. 6—THIRD PIPE LINE UNDER CONSTRUCTION

riveted band joints—II., Fig. 2—which are so extensively fitted on these pipe lines, can be said to be the most satisfactory type of high-pressure joint, and their use can be confidently recommended for working pressures above 2500ft. head. It has, however, to be taken into consideration that an efficient joint is only assured when the conical faces of the pipe ends and bands are carefully machined and fitted together. Nevertheless, this type of joint is undoubtedly in every way most efficient for high-pressure pipe lines in which heavy plate thicknesses come into question, except, naturally, where flanges have to be employed for connecting to bends, valves, &c.

Of the other half-tone engravings accompanying this article, Fig. 5 shows work proceeding with the concreting-in of the bends at the lower end; while in Fig. 6 is shown the third pipe line in course of erection.

A Sketch of the Industrial History of the Coalbrookdale District.*

By RHYS JENKINS.

To the members of the Newcomen Society for the study of the history of engineering and technology Coalbrookdale and its vicinity is a district of exceptional importance. It was at Coalbrookdale that the problem of smelting iron with pit coal, or rather with coke, was solved. On the tramway from Coalbrookdale to Horsehay, cast iron rails were first laid instead of the wooden rails previously used. The first bridge ever built of cast iron, or perhaps of iron in any form, is that which crosses the Severn at Ironbridge, and a little lower down the river was built the first iron boat. At Coalbrookdale were made the first cast iron cylinders for steam engines, and at Broseley one of the very first of Watt's engines was erected.

It is not proposed to deal here with the early history of ironmaking in Shropshire; it will be sufficient to say that the blast-furnace made its appearance in the county about the middle of the sixteenth century, say, fifty or sixty years after its first introduction into England. At the beginning of the eighteenth century there were perhaps half-a-dozen furnaces at work in the county; they were of small capacity, making on an average from 5 to 10 tons of iron per week, and they used charcoal as fuel. One of these furnaces was in Coalbrookdale, and in 1709 it was leased by Abraham Darby, who had previously been in business in Bristol. A few years later he put up a second furnace. I daresay some of you noticed during our visit to-day the date 1658 on a lintel of an old furnace.

For generations the Darby family was intimately connected with Coalbrookdale; from 1709 to 1791 three Abraham Darbys in succession reigned over these works, but with intervals between them, for they were short lived men and left sons under age.

That the smelting of iron with coke was first successfully accomplished at Coalbrookdale is unquestioned, but the published accounts do not agree as to whether it was done by the first or by the second Abraham Darby. In a manuscript account by the late Mr. W. G. Norris, who was the manager of the Coalbrookdale concerns from 1867 to 1897, had access to the records of the company, and was greatly interested in its history,† he gives the credit to the first Abraham Darby, and says that "it has been the united contemporary statement and unquestioned tradition that this," the successful working of the furnace with coke, "was entirely accomplished by him." This statement is supported by remarks which seem to be based on the Coalbrookdale records, but unfortunately the references and quotations are too meagre to be quite satisfactory. However, it does seem clear that the credit is to be assigned to Abraham Darby I., and that coke was in regular use before 1717, the year of his death. It is somewhat remarkable that the process had been in use for thirty years before the appearance of the first mention of it in print—that of Mason in the "Philosophical Transactions" for 1747. Mason visited the Dale in 1745, and we gather from his account that it was at the Dale furnaces only that coke was employed. It seems surprising that in the interval the neighbouring ironmasters had not taken up the new method. Perhaps the explanation lies in a remark of Mr. Norris's that the men employed at the forges to convert the pig into wrought iron objected to the coke pig iron and required to be paid at a higher rate for working it. This meant in practice that the forge-masters preferred to buy charcoal pig, and the coke pig was used only for foundry work, which at the period was not carried on, at any rate to any considerable extent, at any other works in Shropshire.

It is probable that the Horsehay furnace of 1754 was the first outside the Dale at which coke was used as fuel. This was followed in a few years by the Ketley furnaces, and both these works were branches of Coalbrookdale.

A list of furnaces in 1740, which assigns six to Shropshire, does not distinguish between charcoal and coke furnaces. Before the end of the century a vast change had taken place; the coke furnace was in use all over the country, and the total make of pig iron in 1788 was 61,300 tons, as compared with 17,350 tons in 1740, and of this 61,300 tons, 48,200 tons had been smelted by coke. Naturally this extension in the production of coke pig iron was at first most marked in the neighbourhood of Coalbrookdale, and that small area became for a time the largest iron producing district in the country. The list of 1788 shows that Shropshire had 21 coke furnaces, and produced 21,300 tons of coke pig iron, nearly one half the total quantity for England and Wales. The make per furnace, 1100 tons, exceeded that of any other district except Glamorganshire, which showed the same figure. At the same date there were still three charcoal furnaces in Shropshire with an average make of 600 tons per annum. Eighteen years later, in 1806, the number of coke furnaces in the county had doubled, and the make had gone up to 55,000 tons, but the increase for England and Wales had been still greater. Staffordshire had now the same number of furnaces, but showed a lower production per furnace. The Old Park and Ketley works were the largest producers of pig iron in England, but their product was exceeded by that of one of the Welsh works, Cyfarthfa.

A hundred years ago the make of pig iron in Shropshire was about 60,000 tons per annum, and the furnaces numbered 41. They were:—Broseley, 2; Barnetts Leasow, 2; Benthall, 1; Calcutts, 2; Coalbrookdale, 2; Dawley Castle, 2; Donnington Wood, 3; Horsehay, 3; Hadley, 2; Ketley, 3; Lightmoor, 3; Madeley Wood, 3; Old Park, 4; Snedshill, 2; Wombridge, 3; Wrockwardine, 2; Lawley, 1; Langley, 1.

Enough has been said to afford an idea of the great importance of the substitution of coke for charcoal in the smelting of iron. Coalbrookdale was the scene also of an early attempt to use pit coal instead of charcoal in another branch of the iron manufacture, *i.e.*, in converting the pig iron into wrought. In 1766 the brothers George and Thomas Cranege, one of them a workman at the Dale, obtained a patent for "making pig iron or cast iron malleable in a reverberatory furnace with pit coal only." The first experiments were made in an air furnace at the foundry with promising results. A small furnace was then built for the purpose and was worked for some time, but difficulty was experienced through the burning-out of the furnace bottom, and in keeping uniform the quality of the product, so the process was soon given up. This was some fifteen or sixteen years before the date of Cort's epoch-making puddling process.

We may now turn to another phase of the activities of Coalbrookdale, that of ironfounding, and the application of cast iron to new uses. Ironfounding had been carried on in England long before the time of the first Abraham Darby, but the field for iron castings had remained quite a limited one. It is sometimes stated that he invented cast iron pots. This is incorrect; what Darby did was to make a particular shape of iron pot—a bellied pot—in a particular mould—a sand mould. He succeeded in applying a method of moulding already in use for brass pots to the production of iron pots. Dr. Percy's‡ account of this event is very interesting, but as it is rather long and is pretty widely known, it will suffice here to give the main facts. Darby, who had set up in Bristol as a maker of malt mills, entered into a partnership with certain other persons to establish a brass foundry. He procured workmen from Holland, and the foundry seems to have begun its career prosperously. Darby then conceived the idea of making these bellied pots in the cheaper material iron, instead of in brass, and got the Dutch workmen to make the attempt. The attempt was not successful, but their operations had been watched by a lad, John Thomas, then at the works, who thought he saw the reason for the failure. He approached Darby with his idea. Whatever it may have been it seems to have solved the difficulty, and between them Darby and Thomas succeeded in producing a bellied iron pot. Soon after this Darby withdrew from the brass foundry partnership, and, bringing with him young Thomas, came up to Coalbrookdale, where, says Dr. Percy, "the method of moulding arrived at by Thomas for more than a hundred years was practised and kept secret with plugged keyholes and barred doors." This statement is one that we must take for what it is worth, but it does seem that this initial mastering of a technical difficulty indicates the spirit in which the Coalbrookdale foundry was conducted for many years, and that the craft of moulding and ironfounding made great advances there. In respect of ironfounding there can be little doubt that Coalbrookdale soon became one of the leading places, if not the most important place, in the country, and that men who had been trained there were much sought after. We know that when Dr. Roebuck started the Carron Foundry he induced one of the Dale staff, Robert Hawkins, and two or three moulders, to go with him. Another man trained at the Dale was Peter Price, a Cornishman, who founded the now forgotten Neath Abbey Ironworks in Glamorganshire.

The records of the Coalbrookdale firm show that from 1724 onwards they were casting cylinders and other parts of Newcomen engines to be erected in all parts of the country, and for some years they seem to have had a monopoly of this work, at any rate we have no evidence of cylinders being cast elsewhere until about 1760. The use of the engine in the district begins about the year 1740; several were put up about that date or soon after for pumping in mines, and for returning water to the water wheels used to work the bellows of the blast-furnaces.

Although the Coalbrookdale Company was the oldest and largest maker of cylinders for Newcomen engines, the cylinders for Boulton and Watt's engines were made by a rival ironmaster, John Wilkinson, at his works at Bersham, near Wrexham. As most engineers are aware the preference was due to the superior boring machine used at Bersham. Wilkinson owned, among other works, the New Willey blast-furnaces on the Broseley side of the Severn, and to supply blast to these furnaces he put up one of Watt's engines. This was set to work in 1776, and it shares with an engine put up at Bloomfield Colliery, near Tipton, the distinction of being the first of Watt's engines erected outside the Soho Manufactory. The New Willey engine was followed by a number of others in this district, which later became the field of a great many experiments in engine construction. The only one that need be mentioned is that of Heslop; several of his engines were put up here and continued to work for a number of years; possibly some of them are still to be seen. It is related in connection with one of these engines, near Ironbridge, that it was tended by an old woman—a rare instance of a woman carrying on engine driving as a vocation.

To go back to earlier days and deal with the application of cast iron for the rails of tramways; just as with the introduction of coke for iron smelting, we have two stories. According to one this material was first used by Abraham Darby II. on the tramway between Horsehay and Coalbrookdale, say, between 1750 and 1763. According to the other the credit is to be assigned to Richard Reynolds, who was the manager from 1763 to 1768. Mr. Norris's account does not mention the first story, but makes it clear that Reynolds was instrumental in laying down a considerable amount of iron rails between Ketley, Horsehay and the Dale; he says that in the years 1768–1771, inclusive, 800 tons of cast iron rails were laid. It is possible that a short experimental length of line had been laid by Darby, and this proving satisfactory, upon his death in 1763, it fell to Reynolds to carry out the idea on a large scale. Norris does say that Darby for the wagons used a cast iron wheel, with an inside flange, and a cast iron axle.

The application of cast iron that remains to be mentioned is that to bridge building. The bridge across the Severn at the place which has become known as Ironbridge was the first bridge, and indeed the first large structure of any kind, made of cast iron. It was erected in 1779, and is of 100ft. span; the land arches on the Broseley side were not parts of the original structure, they were added in 1800. The members of this bridge were cast at Coalbrookdale by Abraham Darby III., who was one of the most active promoters of the scheme for replacing the old ferry by a bridge. In this project Darby had the powerful assistance of John Wilkinson, another great advocate of the extended use of cast iron.

Wilkinson, as we have already seen, owned the New Willey furnaces in Broseley parish; from the furnaces he had laid a tramway to the river at a point a mile or so below Ironbridge. His wharf—Willey Wharf—was the place where he built the first iron boat in 1787. It was a barge intended for conveying the products of the Willey works down the Severn. The following years saw the construction of other barges at the same place.

So far we have been considering only the manufacture and applications of iron; certainly it is in this connection that the district stands out most boldly, but a good deal may be said about other industries.

At the Calcutts, on the southern side of the Severn, between 1780 and 1790, Lord Dundonald set up works for the distillation of pit coal. He coked the coal in large ovens and recovered the by products. His process was taken up in other parts of the country, and it seems likely that the process of producing coke in ovens, as distinguished from coking in mounds in the open, proceeded from his invention. It should be stated, though, that the production of mineral pitch and tar had been carried on at Broseley by Martin Ele, at least a century before Lord Dundonald entered the field.

The clay industries are still of great importance in the district. The manufacture of tobacco pipes at Broseley seems to go back to Stuart times. In the last quarter of the eighteenth century porcelain works were set up at Caughley and Jackfield; they were not of long continuance, but the Coalport works, which goes back to 1800, seems to have been a continuation of these older establishments.

It would have been interesting to have traced out the canal system constructed to connect the various iron and coal works with the Severn at Coalport, but we must content ourselves with a reference to another first for the district. The plan of using inclined planes instead of locks on canals was the invention of William Reynolds, the eldest son of Richard Reynolds of Ketley, and a man of great technical and scientific ability; it was first applied in 1788 to deal with a drop of 73ft. at the Ketley end of the canal from Oakengates to the Severn.

This rapid survey has not exhausted all the matters of industrial interest that the district contains, but enough has been said, I trust, to whet your appetites and to induce some of you to go deeper. I feel sure there is more to be found out yet.

* Read at the Summer Meeting of the Newcomen Society, Shrewsbury, June 19th, 1924.

† This MS. appears to have been utilised in the preparation of the "Industries" section of "The Victoria History of Shropshire."

‡ Iron and Steel, p. 886.

The Motor Passenger Liner Aorangi.

THE quadruple-screw mail and passenger liner Aorangi, which was successfully launched from the yard of the Fairfield Shipbuilding and Engineering Company, Limited, at Govan, Glasgow, on Tuesday last, marks an important forward step in the history of British marine engineering practice. Not only is this new liner the first ship of her size and type to be propelled by marine oil engines arranged on four shafts, but the engine units are larger in output than any motor ship engines which up to the present have been put into service.

The name of the ship is particularly an appropriate one, for it perpetuates the memory of the old Aorangi, a famous ship of her time, and one of five with which in 1883 the New Zealand Shipping Company first began its operations. It is also noteworthy that this ship was built by John Elder and Co., of Govan, a Clyde shipbuilding firm of renown, which later was succeeded by the Fairfield Company. The following are the principal dimensions and particulars of the new vessel, which it is hoped will be completed towards the end of the year.

Hull particulars—	
Overall length	600ft.
Breadth	72ft.
Depth to lowest weather deck	46ft. 6in.
Cargo space	225,000 cubic feet
Refrigerated cargo space	90,000 cubic feet
Gross tonnage	20,000 tons
Displacement	23,000 tons
Service speed	18 knots
Machinery particulars—	
Type of machinery	Quadruple-screw Fairfield-Sulzer two-cycle
Number of cylinders per shaft	6
Total output per shaft	3250 brake horse-power
Diameter of cylinders	27½in.
Stroke	39in.
Normal speed	127 revs. per minute
Piston speed	825ft. per minute

The ship has finely designed lines and her cruiser stern gives her a handsome appearance. Unlike the early motor ships of Scandinavian origin, the Aorangi will, when completed, differ very little in outward form from liners which are propelled by reciprocating engines or steam turbines, two large funnels, with two tall masts, giving a stateliness which accords with the best British traditions in liner

design. The passenger accommodation is arranged on the main, upper, shelter, promenade and boat decks, and provision is made for about 440 first-class passengers, 300 second-class passengers, 230 third-class passengers, together with a complement of 330 officers and crew. The number of the crew is notable, considering that all the firemen and trimmer ratings have been practically eliminated. The public rooms of all classes bear evidence of careful thought, both in their architectural design and the quiet dignity of the furnishing and decorative schemes.

With regard to the cabins in the various classes, eight first-class cabines-de-luxe, with attached bathrooms, are provided. In the first-class accommodation no less than 11 per cent. of the passengers will be provided with single-berth cabins, 76 per cent. in two-berth cabins, and the few remaining in three-berth cabins. Second-class cabins of the single and two-berth type have in the main been employed, and a very few four-berth cabins are fitted. A considerable number of two-berth cabins are provided for third-class passengers. In no case are there more than four berths to a cabin in this class, and open emigrant sleeping accommodation has all been eliminated. All corridors and access spaces are wide, and the cabins are provided with natural and forced ventilation by ozonated air. The sanitary equipment incorporates the newest designs and improvements. A notable feature of the deck arrangement is the ample promenade space which has been reserved for eachcla ss of passengers. Another interesting feature is the large supply of fresh water which is as well as chemical extinguishers, and Fire-foam plants in all oil fuel, kitchen, galleys and machinery compartments.

The oil fuel bunkers are large in capacity, and are placed amidships between the main engine-room and the room set apart for auxiliary machinery and the steam heating boilers. The advantage of the marine oil engine as regards the vessel's supply of fuel is strikingly illustrated by the fact that the Aorangi's bunkers contain sufficient fuel to carry her over the whole of her round voyage from Vancouver, Canada, to Sydney, New South Wales, and back again. Such a voyage represents a total distance of 15,000 nautical miles, and is equal to about five trips across the Atlantic.

THE MAIN PROPELLING MACHINERY.

In the table earlier in the article we have given some of the leading particulars of the ship's machinery, which represents a steady and sure advance on previous motor ship practice. The engines, it will be noted, run at the relatively high speed of 127 revolutions per minute, which is the nominal speed when each unit is developing 3250 brake horse-power, corresponding to a total output of 13,000 brake horse-power and a service speed for the ship of 18 knots. Great care has been taken to avoid vibration in any form, and with this end in view the propeller shafts have been so proportioned in length and diameter that absolutely steady running at all working speeds will be obtained. A notable feature of the recent shop trials of the engines was, we learn, the absence of tremor at any part of the engine, both during the normal speed and the over-speed trials.

In an article which appeared in THE ENGINEER of March 21st we gave the results of the shop trials, with the fuel consumptions obtained, and some of the outstanding characteristics of the engines were described. We may briefly refer to rigid bed-plate and heavy columns. The engine bed-plates are bolted both on the inside and outside direct to the tank top, and the depth of the girders below the engines is about 5ft. 6in. Another interesting modification to the usual design is the provision of a Michell type thrust bearing in the middle of the vertical shaft which drives the cam shafts.

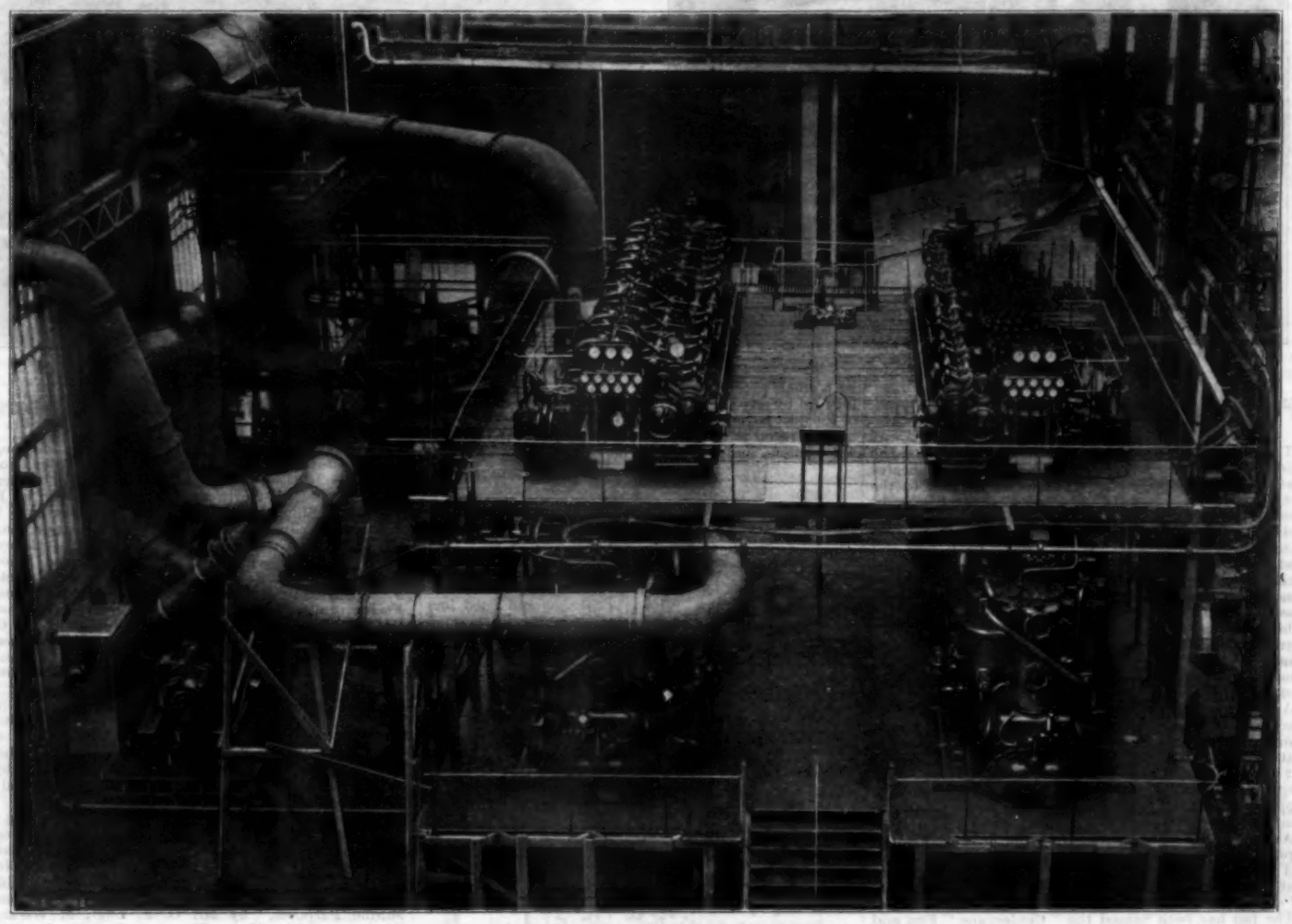
The illustration accompanying to-day's article shows two of the engines, arranged on the test bed, with one of the electrically driven scavenge blowers on the left. In the ship there will be three sets of such blowers, which are rated so that one blower will suffice for one pair of engines, giving a complete stand-by set. The blowers are of the Brown, Boveri adjustable diffuser type, each driven by a direct-current motor of 430 brake horse-power. At normal loads only about 300 brake horse-power, or 200 kilowatts, will, we are informed, be required, and the range of speed of the blowers will vary between 2300 and 3050 revolutions per minute. A new type of light automatic plate valve is employed to admit the air from the scavenge main to the cylinders of the engines. These inlet valves consist of a series of discs, which are raised by the pressure of the air—about 1.75 lb. per square inch—and cause the air to enter the cylinder as soon as the exhaust pressure falls below the air pressure above named. The above illustration shows the two three-stage air compressors, which are placed at the forward end of the engine, and are driven from an extended crank shaft which is furnished with two cranks set at 180 deg. The air compressor suction control levers are arranged on the starting platform. In addition to the two direct-driven compressors on each engine, there are also two motor-driven Reavell vertical type air compressors, which should ensure a sufficient supply of compressed air under every possible condition of operation. We need hardly comment on the familiar Sulzer top platform control. The four engines will be placed abreast in the ship, and the roomy top platform will be seen in the above illustration. The starting and running controls are neatly grouped at the forward end of the engine, which is a new arrangement, and one which permits the engineer on duty to walk rapidly from one control station to the other.

An interesting control device is the provision of two levers, one on the upper starting and running platform and one on the lower platform, which allows of the whole four engines being stopped simultaneously in case of emergency.

Reference may be made to the auxiliary pumps. Contrary to the previous general practice with Sulzer type engines, each engine only drives one auxiliary pump, which supplies lubricating oil to the main crosshead pins at a pressure of 250 lb. per square inch. The oil for the main lubricating circuit, which is maintained at a pressure of 7 lb. to 8 lb. per square inch, is supplied by separate electrically driven pumps. The main crosshead guides are oil cooled. Cooling water for the cylinder covers, liners and pistons is furnished by electrically driven pumps placed in the engine-room.

The auxiliary engines which supply power for the turbo-blower motors, the engine-room and deck auxiliaries, and also the motors used in the kitchen and laundry, &c., as well as providing all the lighting, are placed in a separate room forward of the engine-room, from which it is divided by the amidships fuel oil bunkers. These engines are also of the Sulzer type, and are four in number. They are 400 brake horse-power engines, direct coupled to generators, and the sets are each designed for an output of 250 kilowatts when running at a normal speed of 200 revolutions per minute.

All the main engines and the auxiliaries were seen in the shops on the day of the launch, and the machinery will be placed aboard the ship at an early date. The trials of the Aorangi may be looked forward to with keen interest, for she is a pioneer ship in the application of marine oil engines to large liner practice, and there is little doubt that she will prove worthy in every respect of the care in design and construction which has been bestowed on her by her builders, and of the progressive policy of her owners, the Union Steamship Company of New Zealand.

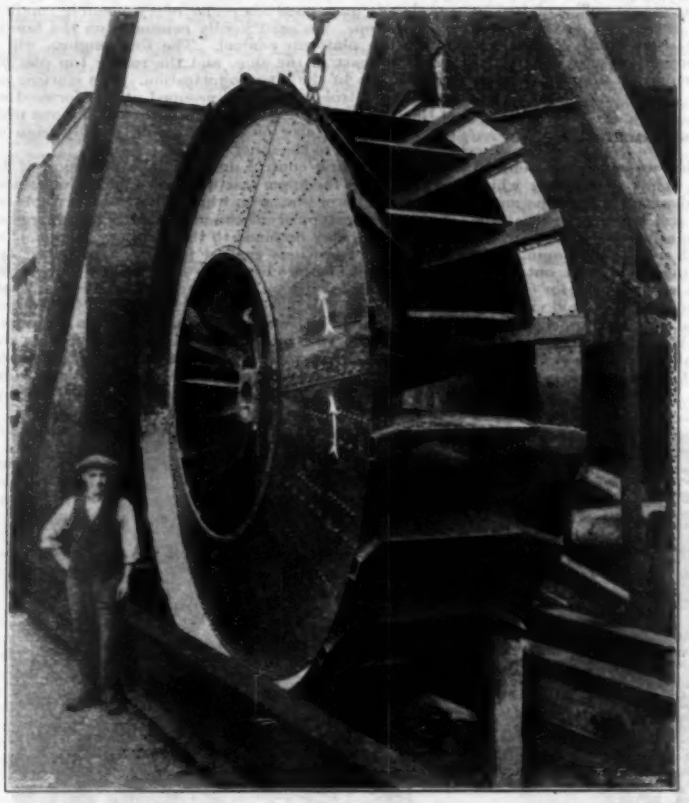


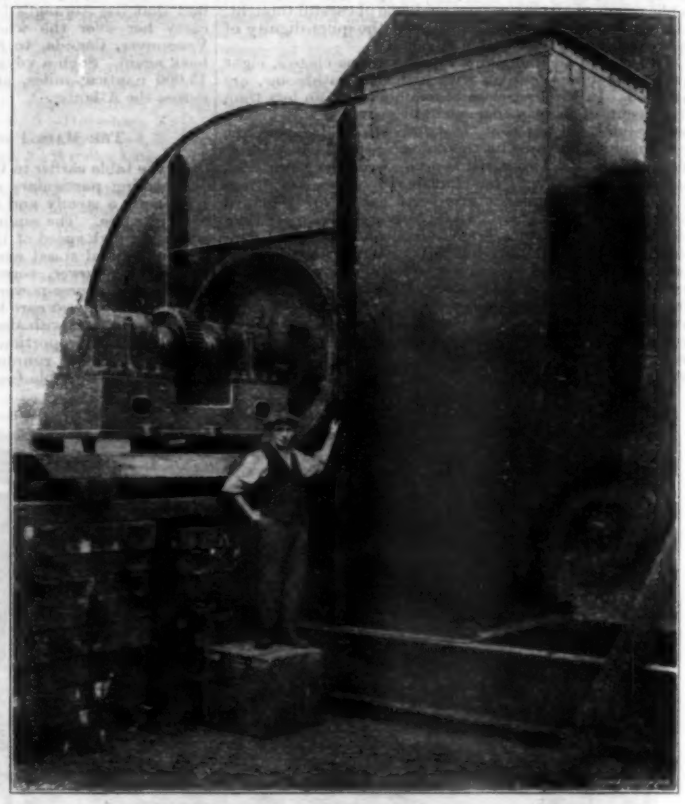
TWO 3250 B.H.P. FAIRFIELD-SULZER ENGINES FOR THE LINER AORANGI

THERE is said to be a field in the north-west of Tasmania embracing 30 square miles, in which osmiridium is known to exist. At present a considerable area of the field is inaccessible, from a miner's point of view, owing to dense scrub. The Tasmanian Government is being asked to have tracks cut, with a view of opening up the osmiridium areas.

"CINDERVANE" FAN FOR STEPNEY POWER HOUSE

THE STURTEVANT ENGINEERING COMPANY, LIMITED, LONDON, ENGINEERS





Flue Dust and Forced Draught.

THE increasing attention which is being paid to the solid matter emitted from power-house chimneys indicates that public authorities are beginning to awaken to the fact that smoke is not the only nuisance which may be associated with the working of large boiler installations, and that, when forced to the limits now common, the boiler furnaces may send up the smoke stack sufficient cinder and ash to produce a local nuisance. Especially is this the case when powdered fuel is used, and practically none of the ashes are collected in the ash pit. In many cases the nuisance is glossed over, on account of the habitually shabby surroundings of the power-house, but even then it would be a decided advantage if the grit were eliminated from the chimney gases, as it may, for instance, cause considerable trouble in nearby cooling towers by choking up the water-distributing system.

At the present time several different systems are being tried for overcoming the trouble, and one of the latest plants for the purpose to be installed in this country is that shown in the accompanying engravings. It is being put down in connection with the new boiler plant of the Stepney Corporation electricity department, and has been supplied by the Sturtevant Engineering Company, Limited, of 147, Queen Victoria-street, London, E.C. 4.

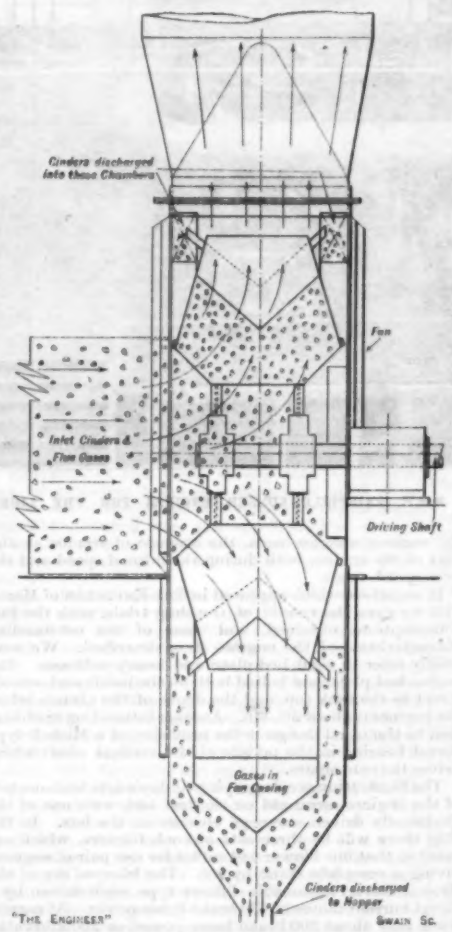
As will be readily gathered from the illustrations, the apparatus combines the dual functions of a dust separator and an induced draught fan, and the makers inform us that it has been proved, in America, to be a most successful arrangement in both respects.

The fan has been named the "Cindervane" Fan and is of the paddle-blade type, that is to say, the blades are flat and radial. The tip of each blade is deeply notched, and on the edges of the vee so formed a steel channel section is riveted on the leading face. On the upper surface of the channels a secondary plate is riveted. In this manner a W-shaped pocket is formed on each blade. In this pocket the ashes collect, and are ejected through the spouts formed by the channel sections. This arrangement is shown most clearly in the reproduction from a photograph. Inside the main fan casing there is arranged a second casing, with an annular slot in which the projecting channels can rotate, and within the second casing there is the usual volute for the discharge of the gases. The space between the two casings provides a pocket into which any grit is projected, along the channels, by centrifugal force, while the gases are slightly deflected and pass away by the volute in the normal manner. The dust and grit fall to the bottom of the casing, as indicated in the diagram, and are discharged from the hopper at convenient intervals.

It might be thought that the grit, impinging on the blades and casing at a fairly high velocity, would have a serious eroding effect on the metal; but the makers assure us that fans of this type which have been in service for as much as six years show that there is no appreciable wear on the blades. Any wear of the plating of the dust chambers is taken care of by means of a renewable strip of plate which can be replaced without much trouble.

The fan illustrated, which is 10ft. in diameter, is to be driven through an inverted tooth silent chain, as it runs at a comparatively slow speed, and is to be geared down from a high-speed electric motor.

It has been found, we understand, that under ordinary working conditions over 90 per cent. of the grit contained in the gases entering the fan is extracted. Practically the whole of the large grit is removed, but there must always be a small percentage which is so fine that it is carried forward by any air velocity used in practice. This portion of the dust is, however, so fine that it will normally be held in suspension at the top of the chimney by the ordinary air currents, and will not be deposited in the immediate



SECTION THROUGH "CINDERVANE" FAN

neighbourhood of the stack. It is the heavier part of the grit which falls immediately round the power-house that causes trouble and annoyance in the neighbourhood.

A PROFIT of £25,694 on its water undertaking is recorded by Leeds Corporation.

INSTITUTION OF NAVAL ARCHITECTS.

As previously announced the summer meeting of the Institution of Naval Architects will be held jointly with the Institution of Engineers and Shipbuilders in Scotland and the North-East Coast Institution of Engineers and Shipbuilders, in London, Glasgow and Newcastle, from June 25th to July 2nd. In our issue of June 6th we gave an itinerary of the various social events and visits which have been arranged. The following papers will be read and discussed at two meetings, which are to be held on Wednesday, June 25th, and on Friday, June 27th, from 10 a.m. to 12.30 p.m., in the Great Hall of the Institution of Civil Engineers, Great George-street, Westminster. On Wednesday the meeting will be opened by his Grace the Duke of Northumberland, president of the Institution of Naval Architects, and the following papers will then be taken:—(1) "Ship Design," by Sir John H. Biles, K.C.I.E., hon. vice-president; (2) "Advanced Naval Bases," by Mr. S. F. Stagles and Captain D. J. Munro, C.M.G., R.N. ret.; (3) "Steering in Shallow Waters," by Mr. G. S. Baker, Member of Council; (4) "Passenger Ship Design from an Independent Point of View," by Mr. John Anderson and Mr. Robert Steele, B.Sc.

At the meeting on Friday further papers will be read as follows:—(5) "A Retrospect of Marine Engineering and Possible Lines of Development," by Sir Archibald Ross, Member of Council and president of the North-East Coast Institution of Engineers and Shipbuilders; (6) "A New Type of Double-acting Diesel Engine for Marine Purposes," by Mr. G. J. Lugt, of Werkspoor Works, and Mr. Harry Hunter; (7) "Displacement—Draught Formulæ," by Mr. W. H. Riddlesworth, member of the Institution of Engineers and Shipbuilders in Scotland.

INSTITUTION OF GAS ENGINEERS.

THE annual general meeting of the Institution of Gas Engineers will be held in the building of the Institution of Electrical Engineers, Victoria Embankment, London, on Tuesday, Wednesday and Thursday, June 24th to 26th inclusive.

The following is the order of proceedings:—On the Tuesday morning, at 10 a.m., after the transaction of the usual business and the presentation of the Institution's Gold Medal and Diplomas, the president, Mr. Samuel Tagg, M. Inst. C.E., the engineer and manager to the Preston Gas Company, will read his opening address. Thereafter the eleventh report of the Gas Investigation Committee will be discussed. In the afternoon the twelfth and thirteenth reports of the committee will be considered. In the evening, at 8 p.m., there will be a reception and dance at the Connaught Rooms, Great Queen-street, at the invitation of the President and Mrs. Tagg.

On the Wednesday morning, after a meeting of the Benevolent Fund and other business, a paper on "The Regenerative Coal Gasification System at Aylesbury," by Mr. A. G. Lane, will be read and discussed. In the afternoon at 3.15, after discussion on a report of the Institution Gas Research Fellowship on "The Gasification of Coke in Steam, with Special Reference to Rates of Gasification in Composition of Gas Produced," by

Dr. Stuart Paxton and Professor John W. Cobb, a paper on "Silica Gas Retorts," by Mr. W. Emery, of Stoke-on-Trent, will be considered. The report of the Refractory Materials Joint Research Committee will then be introduced by Mr. L. P. Leather, the hon. secretary to the committee, and discussed.

On the Thursday morning, at 10 a.m., a paper on "The Construction of the New Coal Gas Works at Garston" will be read by Mr. R. E. Gibson and discussed.

The party which is visiting Paris for the celebrations of the centenary of the gas industry in France, and the Jubilee of the Société Technique de l'Industrie du Gazon France, and the Gas Exhibition, will leave Victoria Station—South-Eastern and Chatham—at 4 p.m.

LAUNCHES AND TRIAL TRIPS.

ATLANTIDA, steamer; built by Workman, Clark and Co., Limited, to the order of the Standard Fruit and Steamship Company; dimensions, 365ft. by 50ft. beam. Engines, four-crank triple-expansion; constructed by the builders; trial trip, May 27th.

INVERBANK, twin-screw motor vessel; built by Harland and Wolff, Limited, to the order of the Bank Line, Limited; dimensions, 434ft. by 53ft. 9in. by 37ft.; 5200 gross tonnage. Engines, two sets of six-cylinder Diesel; constructed by the builders; delivered, May 29th.

MUNAHI, train ferry steamship; built by W. Denny and Brothers, Limited, to the order of the Crown Agents for the Colonies; dimensions, 240ft. by 45ft. by 10ft. 6in.; to carry 380 tons. Engines, two sets of compound diagonal surface condensing, pressure 140 lb.; constructed by the builders; trial trip, May 29th and 30th.

SLIEDRECHT, motor vessel; built by Rotterdamsche Droogdok Maatschappij, to the order of the Stoomvaart Maatschappij "de Maas;" dimensions, 370ft. by 53ft. by 28ft.; to carry 6500 tons deadweight. Engines, six-cylinder Burmeister and Wain type motor; constructed by Harland and Wolff, Limited; launch, May 31st.

BIRCHBANK, twin-screw motor vessel; built by Harland and Wolff, Limited, to the order of Andrew Weir and Co., Limited; dimensions, 434ft. by 53ft. 9in. by 37ft.; 5200 gross tonnage. Engines, two sets of six-cylinder Diesel; constructed by the builders; launch, June 2nd.

KOODOO, twin-screw steamer; built by J. I. Thornycroft and Co., Limited, to the order of the Union Castle Steamship Company; dimensions, 90ft. by 19ft. by 8ft. Engines, two sets of compound inverted surface condensing, 10½in., 21in. diameter, 16in. stroke; constructed by the builders; launch, June 3rd.

MARSELLA, twin-screw tanker; built by the Rotterdamsche Droogdok Maatschappij; dimensions, 305ft. by 50ft. beam; 2698 gross tonnage. Engines, two triple-expansion; constructed by the builders; trial trip, June 3rd.

FORESTASH, self-trimming collier; built by Swan, Hunter and Wigham Richardson, Limited, to the order of the Forest Shipping Company, Limited; dimensions, 240ft. by 37ft. 2in.; to carry 2300 tons. Engines, triple-expansion, pressure 180 lb.; constructed by MacColl and Pollock, Limited; trial trip, June 4th.

DEWSTONE, self-trimming collier; built by Swan, Hunter and Wigham Richardson, Limited, to the order of the Crete Shipping Company, Limited; dimensions, 235ft. by 36ft. by 17ft. 6in.; 1750 tons deadweight. Engines, triple-expansion; constructed by the builders; launch, June 5th.

SAFAJA, steel screw motor tug; built by J. Samuel White and Co., Limited, to the order of the Egyptian and Sudan Government; dimensions, 70ft. by 20ft. by 10ft. Engines, one Vickers-Petters marine crude oil, six cylinders, 14in. diameter by 18in. stroke; constructed by Vickers-Petters, Limited; trial trip, June 5th.

SHANKLIN, paddle steamer; built by J. I. Thornycroft and Co., Limited, to the order of the Southern Railway Company; dimensions, 190ft. by 26ft. by 9ft. Engines, compound diagonal surface condensing, 27in., 51in., and 54in. stroke, pressure 130 lb.; constructed by the builders; launch, June 6th.

BRITISH MAIDEN, motor tanker; built by James Pollock, Sons and Co., Limited, to the order of the British Tankers, Limited; dimensions, 94ft. by 19ft. 3in. by 6ft. 5in.; 140 tons deadweight. Engines, four-cylinder "Gardner" marine; constructed by the builders; trial trip, recently.

STOURGATE, motor tanker; built by James Pollock, Sons and Co., Limited, to the order of the Anglo-American Oil Company, Limited; dimensions, 90ft. by 19ft. by 7ft. 3in.; 115 tons of spirit in bulk. Engines, 135 brake horse-power Bolinder direct reversible heavy oil marine; constructed by the builders; trial trip, recently.

MEDOMSLEY, steel screw steamer; built by Palmers Shipbuilding and Iron Company, to the order of the Medomsley Steam Shipping Company, Limited; dimensions, 375ft. by 51ft. by 27ft., 6500 tons deadweight. Engines, triple-expansion surface condensing, 25in., 41in., 66in. by 45in. stroke; pressure, 180 lb.; constructed by the builders; trial trip, June 11th.

IOSSIFOGLU, motor ship, built by Swan, Hunter and Wigham Richardson, Limited, to the order of the Ionian Marine and Land Investment Company, Limited; dimensions, 400ft., 53ft. 6in., 28ft. 3in., 8250 tons deadweight. Engines, single set of reversible, two-cycle single-acting, Neptune marine oil, six cylinders, each 22½in. diameter by 45in. stroke; constructed by the builders; trial trip, June 14th.

SOBORG, steamer; built by Wm. Gray and Co., Limited, to the order of Mr. C. K. Hanson, of Copenhagen; dimensions, 290ft. 6in. by 40ft. by 21ft. 4in. Engines, triple-expansion, 20in., 31½in., 53in. by 36in. stroke; pressure, 180 lb.; constructed by the builders; trial trip June 16th.

SENTRY, single-screw steamer; built by the Tyne Iron Shipbuilding Company, Limited, to the order of Fisher Renwick Manchester-London Steamers, Limited; dimensions, 230ft. by 34ft. 10in. by 24ft. Engines, triple-expansion, 14in., 30in., 49in. by 33in. stroke, pressure 180 lb.; constructed by the North-Eastern Marine Engineering Company; launch, June 17th.

THE PORT OF HULL.—According to the "Port of Hull Annual" for 1924, Hull, the third largest seaport in Great Britain, continues to hold its proud position, in spite of the slump in trade with the Continent which has been so conspicuous a feature in post-war years. The publication referred to is a well-arranged compendium of all the commercial shipping and industrial activities associated with the Humber, and it contains individual trade reports, with returns of imports, exports, and prices, which are valuable to the trader. Besides shipping and railways, inland water transport facilities are also dealt with, and an account is given of the improvements which have been made in connection with the navigation of the Trent, Aire and Calder. Further information concerning the annual can be obtained from the Hull Trade and Transit Publication Office, 13, Bishop-lane, Hull.

Provincial Letters.

THE MIDLANDS AND STAFFORDSHIRE.

(From our own Correspondent.)

Prices Weakening.

VERY little new business was forthcoming at to-day's meeting of the Midland iron and steel trade in Birmingham. Buyers are still holding off as far as possible, there being little faith in the stability of prices based on present fuel values, particularly blast-furnace coke at 24s. at ovens. Most of the works have this week resumed operations, but consumers' demands are small, and the holidays have interrupted business hardly at all. Manufacturers who were hoping for an improvement in business after the break have so far been disappointed, and there are few signs on the horizon at the moment of any new buying spurt. It is feared in some quarters that nothing of real magnitude will develop until the autumn. The market shows a weakening tendency, especially as regards steel, alike finished and raw, where prices are being shaded, and pig iron, where there is a decided fall in values. A few consumers have come forward with inquiries, but there is practically no forward buying, in view of the falling tendency of prices. The fuel position is easier, blast-furnace coke being obtainable at 23s. per ton at ovens and in special cases 1s. less.

Raw Iron Prices.

Prices of Midland brands of pig iron continue to weaken. Forge material has fallen 2s. per ton and foundry sorts 1s. per ton. North Staffordshire forge continues to be quoted £4 7s. 6d. and foundry £4 15s. Northamptonshire brands command £4 3s. for forge and £4 10s. for No. 3 foundry. Derbyshire forge sells at £4 6s. and foundry ranges from £4 13s. to £4 14s. Derbyshire makers are now enabled to take a share of the business available in Lancashire, the Midland price now approximating to that of Cleveland. Purchases of pig iron have been so small since Easter that it is assumed many users must be near the end of their resources. Smelters are consequently anticipating a renewal of buying in the near future. A few fair sized sales have been made this week. For the most part, however, consumers continue the policy of hand-to-mouth buying in the expectation that coke will be cheaper next month, and that the prices generally will undergo a corresponding reduction. The price of pig iron is largely dependent on coke values, in which a change has already taken place to the advantage of the consumer. Furnace coke has become rather plentiful, enabling concessions to be obtained for a desirable contract. The official quotation of 24s. is generally disregarded, business being done at 1s. to 1s. 6d. below this figure. Furnacemen are pressing for further concessions, and are hopeful of getting them. Very much depends on the future price of small fuel, which at present is doubtful. Midland blast-furnaces for the most part are selling their output in the execution of old contracts, but so little work is being done in South Staffordshire that very small tonnages of forge iron are called for. Ironmasters are again talking of the necessity of reducing output unless matters mend. I mentioned last week that one of the few active furnaces in the Black Country had been damped down. Other Midland furnaces will, I now understand, almost certainly be withdrawn from service if coke is not forthcoming on appreciably cheaper terms at the end of this month.

Competition in Steel.

In the finished steel department competition for business is keen, and many works are prepared to shade prices for plates, bars, &c., to obtain orders. The recent Wages Board ascertainment showed a considerable falling off in bars and plates as compared with the previous bi-monthly period. More determined attempts at penetration are being made by continental exporters and finished steel can be bought rather favourable from Belgium, joists being quoted at £6 15s. f.o.b. Antwerp, equal to £8 delivered here, against the English figure of £9 17s. 6d. Some rather cheap German plates are also in the market. As Belgian finished steel can be bought at £6 15s. f.o.b. Antwerp, there is considerable inducement to execute orders to foreign destinations with continental steel shipped direct from the port. As regards semi-finished material, recent heavy deliveries have more than covered Midland requirements, and for the time being the demand for billets is poor. The Belgians are keenly touting for business, a recent quotation being as low as £5 17s. 6d. f.o.b. Antwerp, making the delivered price about £6 16s. as against the native figure of £7 15s. Railway work is the chief stand-by of the steel trade just now. The local works are taking fair quantities of steel for wagon building. For some of these contracts iron would be preferred, but as this costs about £3 more than steel the cheaper material is almost invariably used. Further rolling stock contracts are expected to be placed shortly by leading railway companies.

Iron Trade Position.

The high price of Staffordshire finished iron is restricting effective demand and adding to the ratio of overhead costs, while at the same time they are increasing the rateable cost of labour. As I reported in my last letter to THE ENGINEER, the wages of ironworkers under the sliding scale of the Midland Iron and Steel Wages Board have been advanced for the next two months. They have now risen to a point higher than they have touched since the beginning of 1922, being 62½ per cent. above the basis of 13s. 6d. for puddling, against a plusage of 55 per cent. when the current year opened. It might be inferred that the iron trade is prospering, or it would not be able to afford to pay more for its labour. This is contrary to fact, however. The ascertainment, although giving an advance to the workmen, showed a decided falling off in output. This is discounted to some extent by the fact that the Easter holidays occurred in the by-monthly period. Marked bar mills continue to supply bars at £15, and most makers of Crown bars demand £13, though it is said in some quarters that the price is shaded for attractive orders. Nut and bolt bars at £12 are in poor request, the small volume of material which is at the moment called for being chiefly supplied by Belgian houses at round about £8 10s. delivered, a price which gives the Staffordshire manufacturer no chance of successfully competing. What is more, ironmasters with the present high production costs, are unable to reduce their price, if at all, to an extent which would put them on a fighting footing with the foreigner. The Staffordshire mills are chiefly producing re-rolled steel, for which the wagon works provide a useful market. A few years ago there was much talk of the substitution of iron for steel in the manufacture of carriage and wagon underframes, owing to its better resistance to corrosion; but the great disparity in price practically compels the wagon builders to employ a material obtainable at about £3 per ton less than iron.

Rising Sheet Values.

Business in galvanised sheets has been stimulated by the recent rise in prices, and the trade is now assured of activity at least until the autumn. Market values of 24-gauge corrugated sheets continue to rise, and this week a number of firms quote from £18 to £18 5s., though the latter price is in advance of the market. The price reduction of a month ago is criticised as having been uncalled for, and is attributed to the action of one large firm ready to make big concessions to secure full order books. The recent reduction in tin-plates has brought out a little new business.

The Tube Trade.

The demands of the tube trade are easily satisfied just now, business being on the poor side. Foreign competition for the available business has become more intense. Germany, formerly a keen seller, is again in the market, and America is also taking a hand, especially in South American and Pacific areas. The result is some falling off in the demand for native iron and steel tube strip. Some of the Staffordshire strip mills have scarcely any work to do, demand being poor for bedstead material as well as for tube strip.

Heavy Edge Tools.

Makers of heavy edge tools in this district are again experiencing a busy time, and most of the works are well employed. Business has been very spasmodic during recent months, but, on the whole, the industry has not much to grumble about. Several of the overseas markets have brightened up during the past month, and producers of edge tools here are hoping for a sustained demand for some little time to come.

Coventry Engineering.

Though the unemployment figures for Coventry show an increase, the majority of the motor engineering establishments are fairly well employed. The light car firms generally have a substantial number of orders in hand; in fact, in certain instances they are several weeks behind in production on these alone, and while there is evidence in some quarters that prospective customers are holding their hand in view of possible developments in August, the demand for the most part is keeping up well. Much depends on the ultimate effect of the withdrawal of the McKenna duties, under the stimulus of which the shops have been fully engaged on the present season's programme.

Unemployment.

The latest return issued by the Ministry of Labour shows an increase of nearly 5000 in the number of unemployed persons in the Midlands. The total for the week ended June 2nd was 118,255, being a decrease of 1997 as compared with the previous week, but the figures for June 9th reveal an aggregate of 123,230. This total is made up as follows:—Men, 89,612; boys, 2134; women, 28,398; and girls, 3086. In the Birmingham area there was a decrease on the week of 174, other centres showing decreases being Bilston, Cradley Heath, Dudley, Nottingham, Leamington, Warwick, Oldbury, Peterborough, West Bromwich, and Worcester. The increase is accounted for by Coventry, where the figures have gone up by 145, Derby, Hanley, Leicester, Longton, Northampton, Smethwick, Stourbridge, and Brierley Hill, Tipton, Walsall and Wolverhampton.

LANCASHIRE.

(From our own Correspondents.)

MANCHESTER.

General Outlook.

THE markets here for iron, steel and metals, and, in fact, all the markets are slowly recovering from the Whitsuntide holidays. There were not very many iron and steel men on the Manchester Exchange on Tuesday, which is the most important market day of the week, but later on in the week most people drifted back to business. Unfortunately, there was nothing very much for them to come back for, and general business has still a very languid appearance. It is hoped that the new French Government will help to bring about a settlement of the eternal reparations question; for this uncertainty is one of the causes why business fails to revive. One fears, however, that with regard to the British iron and steel trades there are other causes of stagnation, amongst which may be mentioned the high costs of production. There is as yet very little confidence in the stability of prices, and buying here proceeds on a retail scale just in those markets where it ought to be wholesale.

Metals.

The markets for the non-ferrous metals are in a very irregular condition. Some of the metals seem

inclined to become much dearer; but the improvement is very slow in communicating itself to copper; and yet copper is the very metal which ought to be best capable of a rise. This state of things naturally gives rise to the apprehension that the improvement in other metals is more or less artificial. The position in the American copper market dominates opinion here, and electrolytic copper has been sold recently in America at 12¼ cents per pound. The exchange, of course, makes this price higher here than it looks, but at a normal exchange the price would be equal only to about £58 per ton for the best kind of refined copper. It is a low pre-war price, while the general range of prices in other markets is from 50 per cent. to 75 per cent. above the low levels in the days before the war. Copper, of course, depends very largely upon whether or not Germany will soon be able to resume her normal consumption. The last statistical returns were not so favourable as they have been. America shows an increase instead of a reduction, and the warehouse stocks here are larger. These things would not matter much if there were any life in the demand; but consumers in all centres seem to be particularly languid. In the manufactured section of the trade there is not much change to report. Prices are still comparatively high, and copper sheets for the home trade are charged now at £12 per ton more than 4ft. by 4ft. copper "braziers" for the Indian trade. The expectation, very commonly held a short time ago, that the price of tin would soon fall below £200 and might reach the level of June, 1923, has now almost disappeared. It is true that America, which is the most important consumer now, keeps out of the market to a large extent; but this attitude cannot last very long, and if it does not produce a break in prices very soon it may lead to a sudden rush on the part of America to secure metal. The outlook is, of course, very uncertain; but it is not wise to be too sure that tin will not advance again. The recent spurt in lead is purely of the nature of a squeeze. There is a shortage of prompt metal, and holders are taking advantage of it. The big backwardation on forward lead is sufficient indication of the position. One would say that the only plan for the legitimate consumer now is to buy only what he must until the market rights itself. In the market for spelter business is very quiet, but the spurt in lead seems to have had some effect and rather higher prices have been asked. The highest price quoted, however, is still substantially below the cost of English lead, and this is a very unnatural condition of things.

Pig Iron.

The markets here for foundry iron are, if anything, rather duller than they were before the holidays. It was thought that some orders might have accumulated during the Whitsuntide recess, but one did not see any sign of this on the Tuesday market this week. Probably the cause of the indisposition to buy foundry iron here is the weakness which has been displayed in the Cleveland market. The highest price quoted there is now 90s. on trucks, and this means that Cleveland iron can be delivered in Manchester at only 1s. more than the Midland irons in spite of the 4s. to 5s. difference in the carriage. Consumers of foundry iron here will no doubt now wait as long as they can to see whether Cleveland is coming down another 2s. 6d. per ton, in which case the Manchester prices for the Midland irons must again be modified. Of course, there is no hurry to contract for foundry iron, as one cannot see any probability of higher prices in the near future. There seems to be a prospect of cheaper blast-furnace coke after the end of June, and this will no doubt mean easier prices for pig iron. Sellers of Derbyshire iron here still quote 101s. 6d. per ton delivered; but it might be possible to buy at 101s. Scotch foundry iron is a little easier than it was, but makers threaten to blow out furnaces rather than come down much lower. Here about 113s. 6d. to 114s. is the price for No. 3. Hematite from the East Coast can be bought here at 110s. per ton.

Steel.

One cannot find any change here in the condition of the market for manufactured steel. The demand is feeble, but sellers are unable to put down the prices. Even if the steel-making pig irons, or other raw material, should become a little cheaper, there would still be no margin for the reduction of prices for finished steel. Selling agents here are quoting £9 10s. per ton delivered for joists and angles, about 10s. more for tees; and £10 2s. 6d. for common plates. The prices for continental steel are about £6 10s. to £6 12s. 6d. for joists and angles f.o.b. at Antwerp. The cost is therefore much less than that of British steel; but delivery is very uncertain. It is said that some deliveries due before March have not been made yet.

Scrap.

The market here for scrap materials is quiet and dull, but dealers do not make any change in their prices. The ironworks are still buyers of heavy wrought scrap at £5 per ton delivered, and although the demand is not very large, there does not seem to be any excess of this class of scrap. Cast scrap is more plentiful, and there is some underselling on the part of dealers, but, as a rule, strong dealers quote 90s. for broken machinery metal.

BARROW-IN-FURNESS.

Hematites.

There is a better position to report so far as hematite pig iron production is concerned. The Barrow Steel Company, towards the end of last week, put into operation the two furnaces which were closed down last March. Most of their output will be absorbed by local steel makers. On general home account only a limited business is being done, and users are only placing orders to cover their immediate wants, there being no disposition to place contracts for forward delivery. There have been calls for lower prices, but smelters are not in a position to meet these requests and maintain the old rates. Special iron is in very small request. There is a fair demand for manganese iron in West Cumberland. General overseas trade is quiet. Odd lots are being sent to the Continent now and again, a cargo being dispatched last week from Barrow to Treport, France. Charcoal iron is in steady request, but the output is only small.

Iron Ore.

There is a somewhat better demand for iron ore consequent upon the lighting of the two furnaces at Barrow, and there will be more activity in some North Lancashire mines after Monday next. The importations of Spanish ore have been very quiet for a long time past.

Steel.

The general demand for steel, particularly rails, is quiet all round, and for the business on offer there is a very keen competition. There is nothing being done at the Workington works, but at Barrow the Siemens furnaces are being got ready this week, and on Monday next the rail and other departments will resume operations. Orders, however, are only lightly held. The hoop works and small section mills, together with the steel foundries at Barrow, are well employed.

Shipbuilding and Engineering.

Vickers, Limited, have completed the reconditioning of the steamer Manx Maid for the Isle of Man Steam Packet Company, Limited, and she has undergone successful trials, and is now on the Douglas and Liverpool daily service.

Fuel.

There is a rather better demand for fuel, particularly furnace coke from the East Coast.

Shipping.

There is not much life in the shipping trade at Barrow. A cargo of steel billets for the Barrow Steel Company arrived from Antwerp and another from Ghent last week.

SHEFFIELD.

(From our own Correspondent.)

Depression in Heavy Steel.

THINGS seem to go from bad to worse in the heavy side of the Sheffield steel industry, and also in the pig iron branch. The resumption of work after Whitsuntide was on a smaller scale than before the holidays, this being particularly the case in the cheaper classes of steel. More than half the furnaces devoted to the production of that class of material in the district are now idle. Rotherham and Templeborough are important centres of this trade, and output there has fallen off considerably. A marked decline in the export demand for mild steel in various rolled forms has been experienced of late. Moreover, competition from the Continent is again threatened. In Belgium, Luxembourg, and France, firms have just brought down their prices to a level which may have the effect of securing business from this country. Nor is it only in the raw material and semi-manufactured steel departments that the falling off of trade is noticed. A similar state of things is found on the railway steel side. Several firms engaged in the production of axles, tires and springs and other material, are finding things much quieter than they were, and at none of the plants is full working the rule. The orders given out by the British railway companies are still providing a large amount of work, but trade with overseas markets is not on a satisfactory scale, owing to the severe continental competition that has to be contended with. The boom in the building of wagons for private owners, which kept many people very busy during the first four months of the year, appears now to have come to an end. The number of contracts being given out from this source at present is very small, and the supply is now so large that the probability is that no further considerable additions will be required for some time.

Railway Work for Siam.

Craven's Railway Carriage and Wagon Company, Darnall, Sheffield, has just built an observation car to the order of Prince Purachatra, brother of the King of Siam. His Highness visited Sheffield last week for the purpose of inspecting the car, which he will use on his tours of the Siamese railways, of which he is the head. The car is fitted up with bedroom and lavatory accommodation, all very carefully thought out, together with a business apartment, with equipment for clerical staff. At one end is an ample observation platform, giving a view *en route* of the permanent way, signal arrangements, &c. Special attention was given to the construction of the car with a view of ensuring comfort in the difficult climatic conditions which exist in Siam. The Prince was exceedingly pleased with the way in which the work had been carried out by the firm.

The Lighter Steel Trades.

The condition of the crucible steel trade undergoes periodical fluctuations, and, on the whole, seems to be struggling upwards, although it has a long way to go before it altogether leaves behind the depression from which it has suffered so long. At present, an improvement is reported. The tool makers are taking a large quantity of this class of steel, as well as of the better qualities of Siemens. It is a welcome sign that to an increasing extent consumers are requiring material of good quality. For some considerable time, the demand has been mainly for cheap steel, but this naturally gives unsatisfactory results, and the fact is now being appreciated that it pays to give more money for tools that will have a longer life. There is no better story with regard to high-speed steel than that which I told last week. The various alloys used can now be bought at low prices, but firms supplying them report that their sales since Easter have been very small. The decision to abolish the McKenna duties has had, as was anticipated, the effect of reducing the demand for motor car steel, including cold-rolled material. A considerable amount of trade is still being done, however, the builders of heavy motor vehicles in particular taking a large amount of material. A capital trade is being maintained in permanent magnets, the local makers of which have been busy for a long time.

Stainless Steel and Wire.

Continued progress is reported in the manufacture of stainless steel and iron, the volume of which has gone on increasing for several years. The demand for stainless steel from the cutlery makers is as large as ever, and there have recently been advances in the application of the material to machinery. Its development on very extensive lines is, however, retarded by high prices. The wire rope trade is fairly well employed, and has had a good output during this year, mainly owing to large consumption by the collieries and a good demand from Australia. Small wire ropes for tennis nets are in large request. A fairly satisfactory state of things also characterises the wire industry. The wire rods which form the basis of the trade are drawn partly from this country and partly from Belgium, and the British rod rolling mills are not so busy now as they were earlier in the year.

The Cutlery Trade.

The demand for stainless steel table knives keeps up to a high level, and a large output is maintained, but prices are very keenly cut and profit-making is a difficult matter. Cases are heard of in which small makers' prices for a dozen dessert knives are as much as 10s. to 15s. lower than those quoted by large firms, and it is alleged that this is only possible because workmen in the employ of the small makers often accept wages which are below the standard rate. Some expansion is reported in the trade in scissors and pocket knives, and German competition has grown less acute as regards prices. Speaking generally, the demand for cutlery from the home market is poor. A good trade is being done, however, with Australasia and Canada, and firms having connections with those markets are escaping the prevailing depression. For knives used in various trades and industries there is a good demand. E. Greaves and Son (Casemakers), Limited, of Sheffield, has introduced a novelty in the manufacture of small leatherette cases to hold articles of plate and cutlery. The cases are machine-pressed into shape, so that the body and lid are each in a single piece, and it is claimed that the result is much more satisfactory than the old method of glueing cardboard tops and bottoms to wood rims, while another advantage is that the pressure exerted by the machines stiffens and strengthens the material and makes the case exceptionally durable.

Sheffield's New Waterworks.

The annual report of the Sheffield Corporation water department gives some additional information with regard to the progress of the new works in the Ewden Valley, to which I referred a fortnight ago. At the Broomhead reservoir the embankment has been carried up to within 21ft. of completion, about 533,000 out of 650,000 cubic yards of banking material having been put in position. The puddle has been brought up within the embankment formation. The rubble shingling and pitching of the inner slope is about two-thirds finished. The byewash is approaching completion, and the excavation for the overflow weir and the removal of the slipped material at Waldershelf Knob is proceeding. At More Hall reservoir, the embankment has been raised to within 45ft. of the top bank level, and about one-half of the total quantity of 350,000 cubic yards of banking material has been put into position. The stone toes are finished, and the rubble shingling is well in hand. The tunnel, tail-bay and pool, compensation gauge weir, and river discharge channel are completed. The channel connecting to the pool and seventeen of the thirty-one steps are constructed. The Wadsley service reservoir is practically completed. It was filled with water for testing purposes on February 17th last, and the work is in an entirely satisfactory condition.

Colliery Items.

The Dinnington Main Colliery Company, which was very successful during the past year, announces that it proposes to proceed immediately with the erection of a new coal washery, and to carry out other improvements in the colliery plant. The annual report of the Maltby Main Colliery Company shows, as might be expected, a heavy loss, due to the disastrous explosion which took place last July. The directors state that extraordinary efforts have been made to extend the workings on the side of the pit which was unaffected by the explosion, and with considerable success, but the growth of the output under the restricted conditions must obviously be slow. The linking-up of the electrical plant at Maltby with the plants of the Yorkshire Electric Power Company and the Dinnington and Rossington collieries is practically completed.

NORTH OF ENGLAND.

(From our own Correspondent.)

Cleveland Iron Trade.

THE Cleveland pig iron trade has undergone a slight change for the better this week. The improvement is only relative, but, nevertheless, very welcome after the recent spell of inactivity. A few inquiries are now circulating, both for home and foreign consumers, and they inspire hopes of better things in the near future. The recovery of the franc has not yet gone far enough materially to alter the position so far as continental trade is concerned, but if it continues it will increase the opportunities of overseas business, and already there are inquiries for iron for Italy which look like maturing. For the most part, home consumers are pursuing a cautious policy, confining their operations to purchases to cover early essential needs, as they anticipate a further fall in values, notwithstanding producers' protests that current quotations leave no margin of profit; and that some classes of

material are being manufactured at a loss. Makers, however, have resolutely opposed any attempt to "bear" the price any further, and 90s. per ton is still the quotation for No. 3 G.M.B. Cleveland pig iron. No. 1 foundry iron is still 95s., No. 4 foundry 89s., and No. 4 forge 88s.

Hematite Pig Iron.

The position in the East Coast hematite pig iron trade remains discouraging. Producers are rapidly getting through contracts on hand, and as they are failing to secure orders to follow on, no small amount of anxiety is felt as to the early future. Unless a turn for the better occurs very shortly, there will be further curtailment of output. Mixed numbers are quoted at 97s. 6d. per ton, but that figure could be shaded for a good order, and only 6d. premium is asked for No. 1.

Ironmaking Materials.

Little business is passing in the foreign ore trade. The fact is that in a general way works have covered their needs for months to come, and are only buying odd cargoes for mixing. Best Rubio ore is still nominally 23s. 6d. per ton c.i.f. Tees. The coke market is a little firmer, and sellers of good Durham furnace brands are asking 27s. 6d. per ton delivered at the works.

Manufactured Iron and Steel.

Discouraging accounts are given of most branches of the manufactured iron and steel trade. Foreign bars and semi-steel are being imported at rates with which local makers cannot compete. The galvanised sheet trade is the one bright spot and some of the works are booked up for months ahead. Although quotably unchanged, prices show a downward tendency.

The Coal Trade.

Very dull conditions prevail in the Northern coal trade, and there is no sign of any improving movement, though a few inquiries for the second half of the year are reported to be in circulation. According to German reports, the State Railways are likely to circulate inquiries for English coal for delivery during the ensuing quarter, but no definite details are yet to hand. There are very few contract inquiries on the market for shipment to any continental centre. Nearly all the business passing is through merchants' general trade, and competition for orders is keen and prices tendered are in the main cut to the very lowest levels. For instance, Tyne prime gas coal is stated to be on offer on the Italian market at 32s. 6d. per ton c.i.f., which is only equal to about 22s. f.o.b. This latter figure is substantially below what local sellers will entertain, and the position as regards other coal shows an even wider margin. A little activity is recorded in the Durham coal section. A Newcastle firm has secured the Genoa gasworks contract for 15,000 tons of best Durham gas coals for July–August shipment at 31s. 8d. per ton c.i.f. The Swedish State Railways have placed further orders for Durham steam coals amounting to 60,000 tons for October to December shipment, at 26s. 9d. per ton c.i.f., Stockholm basis, whilst the French Est Railway is negotiating for 20,000 tons of Durham coals for shipment over the next two or three months. The coke trade is without any special feature. Business continues very quiet, but the tone of the market is steady.

Cleveland Miners' Wages Claim.

The Council of the Cleveland Ironstone Miners' Association, at the quarterly meeting this week, decided to press for a substantial increase in wages to meet the high cost of living, and also to urge the mineowners to grant annual holidays each year to the workers with pay. A motion that a request be made for 1s. a day increase in the mechanics' base rates was referred to the Executive Committee. With reference to the continued depression in the industry, the meeting passed a resolution instructing the Executive Committee to ascertain from the owners what action, if any, they had taken with a view to re-starting the mines and quarries at present laid idle, and also whether they had approached the royalty owners for any reduction in the royalty rents as a means of assisting the industry. If no action had been taken, the Council desired to know whether the owners were prepared to co-operate with the Executive Committee in any way that might enable the mines and quarries to be restarted, contending that the men had done their best to achieve this object by working longer hours and accepting heavy reductions in wages.

SCOTLAND.

(From our own Correspondent.)

No Developments.

NOTHING has occurred during the past week likely to cause an improving tendency in the industrial situation, and the general depression is as profound as ever. It has been said that a slightly better feeling exists with regard to the future, but the stagnant nature of the markets does not appear to substantiate such an emotion. On almost all hands a lessening of activities is noticeable, and with the approach of the annual holiday season, there is not likely to be much alteration in the situation for some weeks, whatever change may take place in the meantime.

Pig Iron.

The pig iron market is still comparatively lifeless. Home consumers are only taking small quantities, and are not inclined to consider future requirements at present. Prices, however, remain firm. It is said that continental basic iron is on offer at lower than home figures, but that practically nothing in the way of business has been done. The export demand is perhaps a shade brighter, but little growth in the turnover is reported.

Finished Steel and Iron.

To continue the tale of depression, it can be stated that no improvement of any account has occurred in the steel trade. Despite the recent shipbuilding orders, no increase in the specifications for plates is reported. The output is below capacity and seems likely to remain so for some time. Sectional material may be a little better off than plates, but is, nevertheless, far from active. There is no indication of a change in price, and consumers are only arranging for absolute requirements. Steel sheet makers continue to book a moderate amount of business, chiefly on export account and for the lighter gauges. Orders are not extensive, however, and producers cannot see far ahead. The demand for bar iron is most unsatisfactory. In this trade, also small tonnages are the order of the day, and prospects obscure. A little more business has been done in re-rolled steel, at a shade under £9 15s. per ton, home or export. Very little is being done in scrap material, and prices are inclined to weaken, owing to more plentiful supplies being available.

Coal.

The depression in the coal trade has become even more acute. The market has been very idle and unsteady during the week. Business for export has been comparatively small and also irregular, as only bare requirements are negotiated for. Included in the inquiries are some for fuel over a considerable period, but the collieries are still disposed to hold out for higher prices for forward transactions than those current to-day. Consequently, negotiations are in most cases "nipped in the bud." Despite a slowing down of the output, the collieries in many instances have heavy stocks, and some very keen prices have been quoted in order to effect a clearance. Consumers, however, are showing no anxiety to avail themselves of such offers. Aggregate shipments during the past week amounted to 242,411 tons, against 259,430 tons in the preceding week, and 306,094 tons in the same week last year. The home market likewise is weak. Most consumers are quite content to work off stocks, even to the exhaustion point, rather than buy at present. Even some public concerns are holding off in the meantime. It is stated that many collieries are working at a loss, owing to increased oncosts and curtailed outputs and the low prices obtainable. A continuance of present conditions would mean a temporary stoppage at some of the pits.

WALES AND ADJOINING COUNTIES.

(From our own Correspondent.)

Coal Trade Outlook.

THERE has been but very slight alteration in the general state of the steam coal trade, though there is some satisfaction in the fact that the alteration is in the direction of improvement. The inquiry from abroad continues to be on a meagre scale, but at the same time definite orders held maintain a fair level, though there is nothing outstanding in the matter of their importance. Foreign buyers do not appear to be at all anxious to operate, and in all the circumstances the state of trade might be much worse than it is. At the moment collieries are, on the whole, better placed than they have been for several weeks, and though the docks are by no means well supplied with tonnage and vacant berths are to be seen still, the collieries are comparatively well stemmed for about ten days. Their position is improved partly as the result of the decreased output during the holidays and the fact that production has been suspended at some pits owing to their unremunerative working. This is a factor which has to be borne in mind regarding the future, and the increased costs of working devolving upon colliery undertakings as a consequence of the new agreement. Still, there is this to be said, that although there is not much apparent life in trade, the market is holding up well, and it is possible that an appreciably better complexion might be put on it if only the inquiry from abroad improved generally to even a slight extent.

Collapse of Strike.

When I wrote last week the outlook was very dismal from the labour point of view, as it appeared as if the ranks of the strikers employed by the Great Western Railway Company were likely to be increased. Efforts were being made to embroil the tippers in the stoppage on the part of the railway shopmen, this being on account of the fact that it was alleged that work usually done by some of the men engaged on the oiling of the dock appliances who were on strike had been carried out during the Whitsuntide holidays by officials and clerks. A deputation of the tippers had an interview with the chief docks manager at Cardiff, but exactly what occurred did not become public. It is assumed that the deputation did not cut much ice, and before the extreme end of the week it became very evident that the strike was collapsing as the men who had been out began to return. On Saturday morning it was officially announced that over 100 men at Cardiff had returned, while the whole of the men at Penarth were back at work. At Port Talbot the workmen were ready to take up their duties, so that it was fully expected that by Monday of this week the strike would be at a complete end. This proved to be the case, as the South Wales railway shopmen, who held a mass meeting on Sunday, decided by a large majority, after somewhat lively proceedings, to resume work at midnight the same night.

Colliery Disputes and Stoppages.

The prospects of employment for a number of miners in South Wales is not good; in fact, it is becoming worse. In the case of the Ynysfaio collieries at Treherbert, where the 1400 or so men normally employed have been on strike for about a fortnight on the question of the double shift, the result of a deputation to Sir David Llewellyn was reported to a mass meeting of the workmen at the end of last week, when it was announced that Sir David had informed the deputation that it had been his intention to close the pits for a while if the men had not tendered notices, whilst he could hold out no hope of reopening them until trade revived. The terms which the Blaenavon Company has put forward for the reopening of the Big Pit, where about 1500 men are usually employed, have been rejected by the men. In this instance the terms include the operation of the double shift. The men are pressing for an inquiry by the Ministry of Mines. In the Tredegar district the workmen, numbering about 700, employed by Grahams Navigation Colliery Company, Limited, Sirhowy, have received notices to terminate their engagements, and there are fears that the colliery may be closed down permanently. At Treorchy about 1800 officials and miners employed by the United National Colliery Company, Limited, were given two weeks' notices to end employment. Work at this pit has been irregular for several weeks past.

Iron and Steel Workers' Wages.

THE announcement is made by the South Wales and Monmouthshire Iron and Steel Workers' Sliding-scale Board that for the three months commencing July 1st next there will be an advance in the scale of 0.75 per cent., which will bring the percentage to 61¼ above the standard. The average net selling price of steel rails—20 lb. per yard and upwards—and steel tin bars—all weights—for the three months ending May 31st last, which was the period of the audit, was £8 3s. 8.56d. per ton, that being an increase of 1s. 3.73d. per ton over the previous quarter concluding on February 29th.

Current Business.

Operations on the steam coal market have been quiet, as the amount of fresh business coming to hand has been restricted; but, nevertheless, the tone of the market is a shade steadier, and best Admiralty large coals are on the basis of 28s. to 28s. 6d., while second qualities range about 1s. less. Monmouthshire qualities are rather better stemmed, but there is no improvement to record in dry coals. Small coals remain steady more on account of the reduced output of late. Coke is rather easier, but patent fuel is unaltered. Anthracite coals display no alteration of note.

CATALOGUES.

HOLT AND WILLETTS, Cradley Heath.—Brochure, "Lifting by Modern Methods."

HYATT, Limited, 56, Victoria-street, S.W. 1.—Pamphlet on the Hyatt line shaft bearing.

JOSEPH KAYE AND SONS, Limited, Lock Works, Leeds.—Price list with illustrations of Kaye's oilcans.

ALLEN-LIVERSIDGE, Limited, 106, Victoria-street, S.W. 1.—Copy of a handbook for oxy-acetylene welders, by Mr. Leonard B. Fox.

HENRY HUGHES AND SON, Limited, 59, Fenchurch-street, E.C. 3.—Copy of book on instruments for aerial navigation, by Mr. A. J. Hughes.

THE COPPER AND BRASS EXTENDED USES COUNCIL, King's Court, 115, Colmore-row, Birmingham.—Book on the use of copper and brass for domestic water services.

DURVITE (1909), Limited, Victoria Works, 30, Shepperton-road, New North-road, London, N. 1.—List No. 10, 1924, particulars of Durvite compounds for case hardening.

METROPOLITAN-VICKERS ELECTRICAL COMPANY, Limited, Trafford Park, Manchester.—A calendar for 1924/25.

MICHELL BEARINGS, Limited, South Benwell, Newcastle-on-Tyne.—Parts 1 and 2 of the Michell bearing book, descriptive catalogue and section of standardised bearings which can be supplied from stock.

COVENTRY CHAIN COMPANY, Limited, Spon End Works, Coventry.—The Coventry chain handbook C22, 1924, more especially compiled for engineers in collieries, engineering works, textile mills, flour mills, or anywhere where economic transmission of power is desired.

ALBERT IRON AND STEEL COMPANY, Limited, Farsley-street, Birmingham.—In this pamphlet the "Old Process of Puddled Ironmaking" is briefly described and excellently illustrated. Thereafter the advantages of iron for certain purposes—corrugated sheets, gasholder sheets, wagon underframes, tubes and fittings—owing to its resistance to corrosion, are set forth

PERSONAL AND BUSINESS ANNOUNCEMENTS.

THE STIRLING BOILER COMPANY, Limited, asks us to state that it has moved to more commodious premises at 32/33, Farringdon-street, E.C. 4.

MR. PERCY GRIFFITH informs us that on June 24th next he is moving his offices from 20, Victoria-street, Westminster, S.W. 1, to the ground floor of No. 39, Victoria-street, S.W. 1. New telephone No., Victoria 6011.

MR. CLAUDE M. TOPLIS, who has for the past fourteen years been chief engineer to Stothert and Pitt, Limited, Bath, has resigned that position and taken a partnership in the Bedford Engineering Company, Bedford. Major E. G. Fiegehen is the remaining partner with the latter firm.

A BUFFER STOP COLLISION.—The Great Western station at Snow-hill, Birmingham, is approached from either end by a steeply rising gradient. For the 554 yards before reaching the buffer stops at the end of No. 10 bay the line from the North rises at the rate of 1 in 70 for the first 242 yards and then at 1 in 286 for the remaining length. Steam has therefore to be kept on until quite near to the station. On March 22nd last a motor car train from Stourbridge Junction had to run into this road, and the driver evidently failed to close the regulator sufficiently early. He was working to rule as to relying solely on his hand brake, but the rails, not having been used since the previous evening, were in a bad condition owing to the damp morning, and were particularly greasy. The hand brake did not respond freely and the driver left the emergency application of the vacuum brake until too late. The consequence was that the train ran into the buffer stops, and 65 out of the 180 or so passengers received a shock or slight injury. The train was being driven with the engine in the rear and the driver in the leading compartment of the first coach. The driving compartments are not provided with sanders, and this omission was a contributing factor. Lieut.-Colonel Mount, whose report on the mishap was issued on the 13th instant, says that there are difficulties in making provision in this respect, but as in an emergency the use of sand may be urgently necessary, he hopes that the Great Western Railway Company will give due consideration to the point.

Current Prices for Metals and Fuels.

IRON ORE.

N.W. COAST—	
Native	17/6 to 24/-
(1) Spanish	23/-
(1) N. African	23/-
N.E. COAST—	
Native	—
Foreign (c.i.f.)	23/6

PIG IRON.

	Home. £ s. d.	Export. £ s. d.
(2) SCOTLAND—		
Hematite	5 1 3	—
No. 1 Foundry	5 3 9	—
No. 3 Foundry	4 18 9	—
N.E. COAST—		
Hematite Mixed Nos.	4 17 6	4 17 6
No. 1	4 18 6	4 18 6
Cleveland—		
No. 1	4 15 0	4 15 0
Silicious Iron	4 15 0	4 15 0
No. 3 G.M.B.	4 10 0	4 10 0
No. 4 Foundry	4 9 0	4 9 0
No. 4 Forge	4 8 0	4 8 0
Mottled	—	—
White	—	—
MIDLANDS—		
(3) Staffs.—		
All-mine (Cold Blast)	9 2 6	—
North Staffs. Forge	4 7 6	—
„ „ Foundry	4 15 0	—
(3) Northampton—		
Foundry No. 3	4 10 0	—
„ Forge	4 3 0	—
(3) Derbyshire—		
No. 3 Foundry	4 13 0 to 4 14 9	
Forge	4 6 0	—
(3) Lincolnshire—		
No. 3 Foundry	4 14 6	—
No. 4 Forge	4 13 0	—
Basic	4 11 0	—
(4) N.W. COAST—		
N. Lancs. and Cum.—		
Hematite Mixed Nos.	5 12 6 (a) / 5 17 6 (b)	—

MANUFACTURED IRON.

	Home. £ s. d.	Export. £ s. d.
SCOTLAND—		
Crown Bars	12 10 0	—
Best „	—	—
N.E. COAST—		
Common Bars	12 10 0	—
LANCS.—		
Crown Bars	13 0 0	—
Second Quality Bars	12 0 0	—
Hoops	15 0 0	14 15 0
S. YORKS.—		
Crown Bars	13 0 0	—
Best „	13 10 0	—
Hoops	14 10 0	—
MIDLANDS—		
Crown Bars	13 0 0	—
Marked Bars (Staffs.)	15 0 0	—
Nut and Bolt Bars	12 0 0	—
Gas Tube Strip	13 5 0 to 13 7 6	—

STEEL.

	(6) Home. £ s. d.	(7) Export. £ s. d.
(5) SCOTLAND—		
Boiler Plates	13 10 0	—
Ship Plates, ¼in. and up	10 5 0	—
Sections	10 0 0	—
Steel Sheets, 5/16in. to ¼in.	12 10 0	—
Sheets (Gal. Cor. 24 B.G.)	—	17 15 0

STEEL (*continued*).

	Home. £ s. d.	Export. £ s. d.
N.E. COAST—		
Ship Plates	10 5 0	—
Angles	10 0 0	—
Boiler Plates	13 10 0	—
Joists	10 0 0	—
Heavy Rails	9 0 0	—
Fish-plates	13 0 0	—
Channels	10 5 0	£9 to £9 5
Hard Billets	10 5 0	—
Soft Billets	9 0 0	—
N.W. COAST—		
BARROW—		
Heavy Rails	9 5 0†	—
Light „	9 10 0 to 10 0 0†	
Billets	8 10 0 to 12 0 0†	
MANCHESTER—		
Bars (Round)	10 5 0 to 10 15 0	
„ (others)	10 0 0 to 10 2 6	
Hoops (Best)	15 5 0	15 0 0
„ (Soft Steel)	13 15 0	13 10 0
Plates	10 0 0 to 10 5 0	—
„ (Lancs. Boiler)	13 10 0	—
SHEFFIELD—		
Siemens Acid Billets	12 10 0	—
Bessemer Billets	13 0 0	—
Hard Basic	10 5 0	—
Intermediate Basic	10 0 0	—
Soft Basic	8 15 0	—
Hoops	12 10 0 to 13 0 0	
Soft Wire Rods	11 0 0 to 11 10 0	
MIDLANDS—		
Small Rolled Bars	10 0 0 to 10 10 0	
Billets and Sheet-bars	7 15 0 to 8 0 0	
Sheets (20 W.G.)	11 10 0 to 12 0 0	
Galv. Sheets, f.o.b. L'pool	17 15 0 to 18 0 0	
Angles	9 17 6 to 10 0 0	
Joists	9 17 6 to 10 0 0	
Tees	10 17 6 to 11 0 0	
Bridge and Tank Plates	10 10 0	—
Boiler Plates	14 0 0	—

NON-FERROUS METALS.

SWANSEA—	
Tin-plates, I.C., 20 by 14	22/7½ to 23/-
Block Tin (cash)	£226 0 0
„ (three months)	£225 15 0
Copper (cash)	£61 10 0
„ (three months)	£62 7 6
Spanish Lead (cash)	£32 12 6
„ (three months)	£30 12 6
Spelter (cash)	£32 3 9
„ (three months)	£32 0 0
MANCHESTER—	
Copper, Best Selected Ingots	£67 10 0
„ Electrolytic	£68 5 0
„ Strong Sheets	£94 0 0
„ Tubes (Basis price)	0 1 1½
Brass Tubes (Basis price)	0 1 0
„ Condenser	0 1 2½
Lead, English	£35 0 0
„ Foreign	£34 0 0

FERRO ALLOYS.

(All prices now nominal.)

	Per Ton.	Per Unit.
Tungsten Metal Powder	1/8½ per lb.	
Ferro Tungsten	1/4½ per lb.	
Ferro Chrome, 4 p.c. to 6 p.c. carbon	£24 0 0	10/6
„ 6 p.c. to 8 p.c. „	£23 10 0	8/-
„ 8 p.c. to 10 p.c. „	£23 0 0	8/-
„ Specially Refined		
„ Max. 2 p.c. carbon	£42 10 0	16/-
„ „ 1 p.c. „	£51 0 0	17/6
„ „ 0.75 p.c. carbon	£68 0 0	20/-
„ carbon free	1/5 per lb.	
Metallic Chromium	4/2 per lb.	
Ferro Manganese (per ton)	£17 for home, £17 for export	
„ Silicon, 45 p.c. to 50 p.c.	£12 0 0	scale 5/- per unit
„ „ 75 p.c.	£18 10 0	scale 6/- per unit
„ Vanadium	19/3 per lb.	
„ Molybdenum	8/3 per lb.	
„ Titanium (carbon free)	1/3 per lb.	
Nickel (per ton)	£135	
Cobalt	10/6 per lb.	
Aluminium (per ton)	£92 to £100 (British Official.)	

FUELS.

SCOTLAND.

	Export.
LANARKSHIRE—	
(f.o.b. Glasgow)—Steam	17/6
„ „ Ell	18/9
„ „ Splint	20/- to 21/6
„ „ Trebles	20/-
„ „ Doubles	19/9
„ „ Singles	17/6
AYRSHIRE—	
(f.o.b. Ports)—Steam	17/6
„ „ Splint	20/-
„ „ Trebles	20/-
FIFESHIRE—	
(f.o.b. Methil or Burntisland)—Steam	18/- to 20/9
Screened Navigation	26/6
Trebles	21/-
Doubles	20/6
Singles	17/6
LOTHIANS—	
(f.o.b. Leith)—Best Steam	18/-
Secondary Steam	17/3
Trebles	20/6
Doubles	20/-
Singles	17/9

ENGLAND.

(8) N.W. COAST—	
Steams	30/-
Household	49/- to 59/-
Coke	33/6
NORTHUMBERLAND—	
Best Steams	21/6 to 22/-
Second Steams	20/- to 21/-
Steam Smalls	13/6 to 14/-
Unscreened	18/- to 20/-
Household	27/-
DURHAM—	
Best Gas	23/- to 23/6
Second	20/6
Household	27/-
Foundry Coke	26/- to 28/-
SHEFFIELD—	Inland.
Best Hand-picked Branch	34/- to 35/- —
Barnsley Best Silkstone	28/- to 29/- —
Derbyshire Best Brights	28/- to 30/- —
„ „ House	25/- to 27/- —
„ „ Large Nuts	24/- to 25/- —
„ „ Small „	18/6 to 20/6 —
Yorkshire Hards	23/- to 24/- —
Derbyshire „	21/6 to 23/6 —
Rough Slacks	12/6 to 15/6 —
Nutty „	12/- to 14/- —
Smalls	8/- to 10/- —
Blast-furnace Coke (Inland) *	
„ „ (Export)	f.o.b. 27/- to 28/-

CARDIFF— (9) SOUTH WALES.

Steam Coals:	
Best Smokeless Large	28/- to 28/6
Second „ „	27/- to 27/6
Best Dry Large	26/6 to 27/-
Ordinary Dry Large	25/- to 26/-
Best Black Vein Large	26/6 to 27/-
Western Valley „	25/- to 26/6
Best Eastern Valley Large	25/- to 26/-
Ordinary „ „	24/- to 25/-
Best Steam Smalls	18/- to 18/6
Ordinary „	16/6 to 18/-
Washed Nuts	25/- to 27/-
No. 3 Rhondda Large	28/- to 29/-
„ „ Smalls	24/- to 25/-
No. 2 „ Large	24/6 to 25/6
„ „ Through	21/- to 23/-
„ „ Smalls	16/- to 17/-
Coke (export)	50/- to 55/-
Patent Fuel	28/- to 30/-
Pitwood (ex ship)	26/6 to 27/6
SWANSEA—	
Anthracite Coals:	
Best Big Vein Large	47/6 to 54/6
Seconds	42/6 to 45/-
Red Vein	30/- to 32/6
Machine-made Cobbles	57/6 to 62/6
Nuts	52/6 to 62/6
Beans	42/6 to 45/-
Peas	27/- to 28/-
Breaker Duff	10/- to 10/6
Rubbly Culm	15/- to 16/-
Steam Coals:	
Large	24/- to 26/-
Seconds	22/- to 24/-
Smalls	15/- to 19/-
Cargo Through	18/- to 22/-

(1) Delivered. (2) Net Makers' works. (3) f.o.t. Makers' works, approximate. (4) Delivered Sheffield. (5) Glasgow, Lanarkshire and Ayrshire.

(6) Home Prices—All delivered Glasgow Station. Boiler Plates 10/- extra delivered England. (7) Export Prices—f.o.b. Glasgow.

(8) Except where otherwise indicated, coals are per ton at pit for inland and f.o.b. for export, and coke is per ton on rail at ovens and f.o.b. for export. (9) Per ton f.o.b.

*Blast-furnace Coke (Inland): Special Price for Ironworks 23/-, open market 27/- (at ovens). † Latest quotations available. (a) Delivered Sheffield or Glasgow. (b) Delivered Birmingham.

French Engineering Notes.

(From our Correspondent in Paris.)

German Coke.

THE renewal of the agreement with German firms for the supply of fuel to France has become singularly complicated by the change in the political situation and by the necessity of discussing the recommendations of the Dawes Commission. The existing arrangement is on the point of lapsing, and for some time past the Germans have been retarding consignments of coke on the ground, first, that the recent strikes in the Ruhr restricted supplies, and then that there was barely sufficient for home requirements. The quantity of coke coming from the Ruhr is certainly diminishing every month, and the French are generally of the opinion that the falling off is due to an organised resistance in view of probable negotiations that will enable the Germans to secure some advantage. The outlook is regarded as an extremely serious one, for the French production of iron cannot be maintained without the aid of German coke, and while the country is in the throes of a political upheaval, the iron and steel firms are urging the necessity of safeguarding the interests of the industry during the negotiations which will be carried out for the settlement of reparations. The dependence of the metallurgical industry upon German coke cannot be overlooked, and until there is an assurance that ample supplies will be available for the blast-furnaces there can be no stability in the iron and steel trades.

Coal Carbonisation.

As a means of economising coal the Carbonisation Commission has been investigating all kinds of methods of carbonising the fuel, and it now proposes to place a tax on the selling price of coal and to distribute the proceeds amongst coke oven proprietors and producers of by-products. The idea is to encourage the general use of coke by selling it at a lower price, and thereby to insure supplies of benzol and other products necessary for the national defence. Such combinations have been attempted in the past, notably for the substitution of power alcohol for petrol, but they have never given the desired results, and the proposal of the Commission is being strongly objected to by representatives of the metallurgical trades, who argue that the compulsory use of coke would cause a ruinous revolution in many branches of industry. It is argued that if the use of coke were made compulsory it would take a quarter of a century to transform all the heat plants which are designed to burn coal. Nor is it at all certain that the imposition of a tax on the selling price of coal for the benefit of coke would have the effect of bringing down the price of the latter fuel.

Capital Ships.

There has been some activity during the past week or two amongst associations identified with maritime and shipping matters generally. Naval development is being continued with a unity of purpose that is quite free from the political turbulence, and the programme now being carried out is in no way affected by the policy of retrenchment which was forced upon the country by the partial collapse of the franc. The programme of naval construction is based so completely upon the provision of a homogeneous fleet of very fast and light unarmoured cruisers, destroyers, torpedo-boats, submarines and seaplanes that the idea of building capital ships appeared to have been abandoned. The view is certainly held in many quarters that the capital ship has become obsolete, but most naval officers are of a different opinion. At the annual meeting of the Association Technique Maritime et Aéronautique, Admiral Amet presented a paper on the maximum efficiency of capital ships, and declared that their construction should not be abandoned. He affirmed that under-water craft and seaplanes had not sealed the fate of the capital ship. It is known that the Conseil Supérieur de la Marine has never depreciated the value of the battleship. If the existing programme is restricted to light vessels it is because the country's finances necessitated an economical expenditure, and when the question of building capital ships is discussed, the French will profit from the developments taking place abroad.

Continuous Brakes.

A problem of continuous brakes for goods trains appears to have been brought nearer solution by an invention which is said to have been successfully experimented with in Tunis in the presence of a Commission from the Ministry of Public Works. If the application of continuous brakes to goods trains is meeting with resistance from the railway companies, it is mainly on account of the huge cost involved in equipping the trucks at a time when it is almost impossible to provide the necessary funds. It is true that various firms interested in the Westinghouse brake have associated with a powerful financial group in order to offer facilities to the railway companies for the equipment of goods trains with continuous brakes, but the companies refuse to embark upon this transformation until some definite decision has been come to by the International Conference. Nevertheless, it is claimed that the cost of fitting the brakes will be halved by means of a new device, named the "Chamon," after the inventor, which increases the braking effort in proportion to the load carried on the trucks. In a word, the application of the compressed air or vacuum brake brings into action a mechanical arrangement between the truck frame and the brake shoes whereby the load increases the pressure of the shoes on the wheels. Loaded coal trucks were sent on a down gradient of 20 mm. per metre, and at a speed of between 30 kiloms. and 45 kiloms. an hour were stopped in 250 metres. It is claimed that with this device a train need be equipped with only one-half the number of continuous brakes that would otherwise be necessary. It has been decided to adopt the system on the railways in Tunis and Algeria.

British Patent Specifications.

When an invention is communicated from abroad the name and address of the communicator are printed in italics.

When an abridgment is not illustrated the Specification is without drawings.

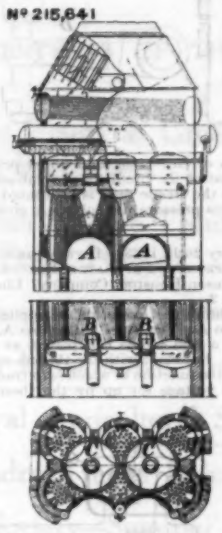
Copies of Specifications may be obtained at the Patent Office Sale Branch, 25, Southampton-buildings, Chancery-lane, W.C., at 1s. each.

The date first given is the date of application; the second date, at the end of the abridgment, is the date of the acceptance of the complete Specification.

STEAM GENERATORS.

215,641. August 18th, 1923.—WATER-TUBE BOILERS. The General Electric Company, Limited, Magnet House, Kingsway, London, W.C. 2, and J. T. Chalk, 17, Carlingford-road, Hampstead, London, N.W. 3.

The boiler described in this specification is of a rather complicated form and, as will be seen from the drawing, is of the

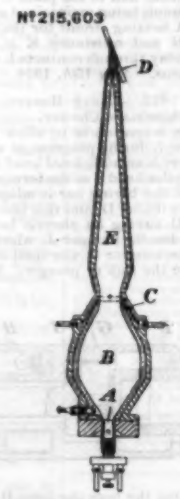


vertical tube type. The chief claims for novelty appear to lie in the provision of separate refractory combustion chambers A A for the individual burners B B, and in the arrangement of some of the water tubes C C, in such a fashion that they help to keep cool the walls of these chambers.—*May 15th*, 1924.

TURBINE MACHINERY.

215,603. June 5th, 1923.—GAS TURBINES, W. MacKirdy, 1816, Alberni-street, Vancouver, B.C.

The inventor proposes to reduce the temperature of the working fluid in an internal combustion turbine by mixing the gases resultant on combustion with air before they arrive at the turbine

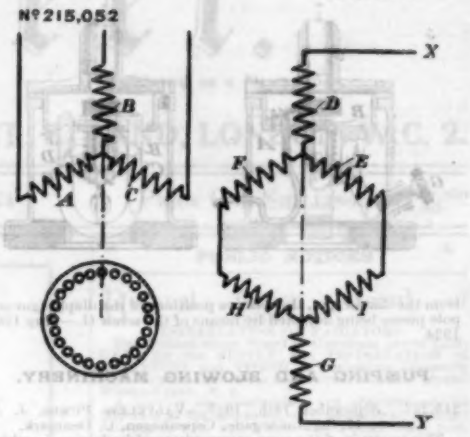


wheel. The combustible mixture from the burner A is completely burned in the refractory lined chamber B, and is then mixed with cold air, drawn in through the annular orifice C, in a similar manner to that employed in injectors, or the air may be supplied under pressure. The final mixture is delivered to the turbine wheel D through the tapered duct E.—*May 15th*, 1924.

TRANSFORMERS AND CONVERTERS.

215,052. January 24th, 1923.—IMPROVEMENTS IN ELECTRICAL PHASE AND FREQUENCY CONVERTERS, Birger Nordfeldt, and the Allmanna Svenska Elektriska, both of Västeras, Sweden.

This specification describes in considerable detail a scheme for changing polyphase current into single-phase current, at the same time changing the frequency of the current. In the diagram A B C are the phases of a three-phase primary winding which may be a stationary or a rotating winding. A corresponding secondary winding is shown at D, E and F. This winding is magnetically interlinked with the primary winding and has the same number of poles as the primary winding, either winding being fixed or movable. Either on the same core as the secondary winding or mechanically coupled to it is another three-phase winding G H I, which is connected to the winding D E F at two points so that there is an opposite phase sequence in the two windings. Under this condition, although rotating fluxes will traverse both windings and create three-phase voltages in them, the voltage

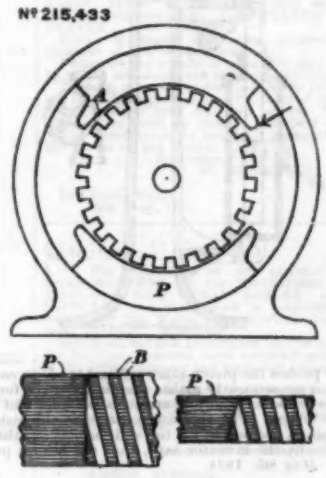


between the two free ends X and Y will be a single-phase voltage equal to three times the two-phase voltage. The principle on which this phase converter works is described.—*April 24th*, 1924.

DYNAMOS AND MOTORS.

215,433. February 7th, 1923.—IMPROVEMENTS IN DYNAMOS AND MOTORS, Matthew William Walbank, of 129, Lambeth-road, London, S.E. 1.

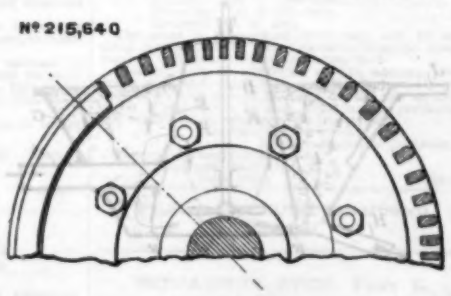
According to this invention the irregularities produced by commutation are eliminated or reduced to a value which enables a dynamo to be successfully used in connection with the triodes



of telephones or wireless circuits. The desired result is obtained by levelling off the edges A of the pole pieces as shown. The armature slots B are also skewed by an amount equal to the tooth pitch of the armature, and the pole pieces P—see the right-hand lower drawing—are skewed in the opposite direction.—*May 7th*, 1924.

215,640. August 15th, 1923.—IMPROVEMENTS IN AND RELATING TO INDUCTION MOTORS, *The British Thomson-Houston Company, Crown House, Aldwych, W.C. 2.*

It is well known that one of the difficulties met with in connection with induction motors with squirrel-cage windings is the loss of torque or the existence of dead points at starting and



at synchronous speeds. According to this invention this difficulty is overcome by spacing the rotor slots unequally as shown in the drawing. The cross sectional area of the slots and conductors in the slots that are spaced far apart have a greater cross sectional area than the other conductors.—*May 15th*, 1924.

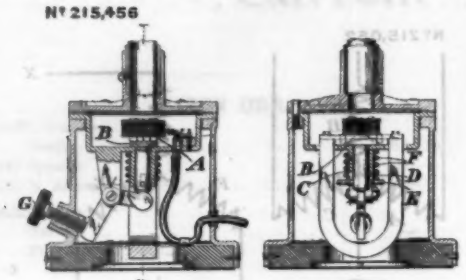
TELEGRAPHS AND TELEPHONES.

215,456. February 12th, 1923.—IMPROVEMENTS IN OR RELATING TO TELEPHONE RECEIVERS, Robert Lambert Murray, of 7, South Coxted-road, West Dulwich, and the Telephone Manufacturing Company, of 42a, Matell-road, West Dulwich.

According to this invention the magnet of a loud-speaking telephone is constructed so that the vibration of the body of the magnet or of its limbs and pole extremities is damped out. A permanent horseshoe magnet is used, and to each of the limbs a soft iron pole piece A is secured and they extend inwardly. On each pole extremity a bobbin of wire is mounted. Beneath the pole pieces is a bar of brass B. Extending from the diaphragm

casing is a tubular guide C which receives a spindle D secured to the brass strip B, and a cross pin E prevents the spindle from rotating. A spring F tends to withdraw the pole faces away

Nº 215,456



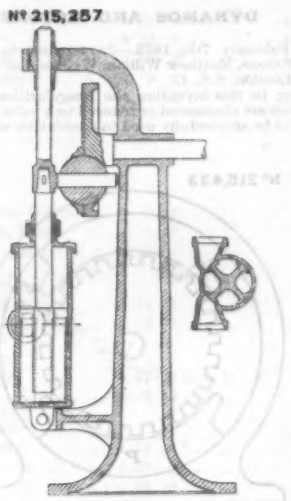
from the diaphragm, the relative positions of the diaphragm and pole pieces being adjusted by means of the screw G.—*May 12th*, 1924.

PUMPING AND BLOWING MACHINERY.

215,257. September 14th, 1923.—VALVELESS PUMPS, J. A. Larsen, 44, St. Annaegade, Copenhagen, C. Denmark.

This pump is of the type commonly used in dairies, in which the piston is oscillated on its own axis besides being reciprocated. The oscillation puts passages in the piston alternatively in communication with the inlet and outlet. In the ordinary type, with the inlet and outlet disposed opposite one another, the difference

Nº 215,257



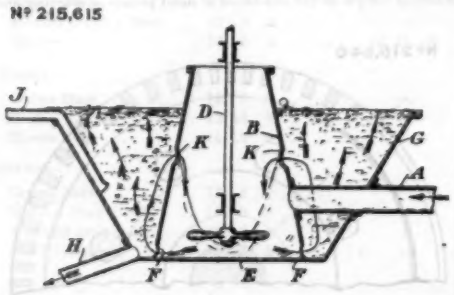
in pressure pushes the piston sideways and tends to cause wear. The inventor consequently makes the piston of the form shown in the cross-sectional plan and arranges the inlet and outlet at an angle of 90 deg. The opposite passages in the piston are in communication, one pair at the top and the other at the bottom, with the result, the inventor says, that the lateral pressure is balanced.—*May 8th*, 1924.

MINING MACHINERY.

215,615. June 18th, 1923.—FROTH FLOTATION CLASSIFICATION, *J. S. Withers*, 51–52, *Chancery-lane, London, W.C.* 2.

In this apparatus the coal slimes or ore, water and a froth-producing substance are continuously admitted into the mixing vat B through a pipe A. The mixing and agitating apparatus comprises a spindle D, provided with blades E or wings set in such a manner that the liquor is mixed and agitated, and it is transferred through openings F near the bottom into the frothing vat G surrounding the mixing vat. In the vat G the velocity

Nº 215,615



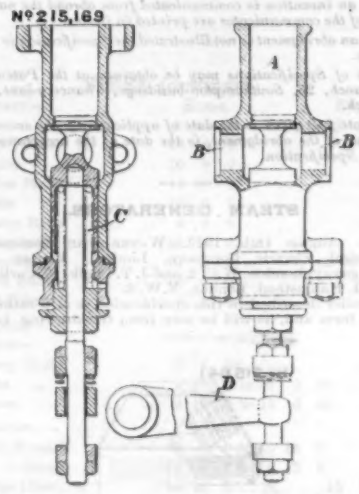
of flow of the liquor is reduced to such an extent that the air bubbles and the relatively pure coal particles entrapped, thereby rise to the surface, whereas the particles having a comparatively high percentage of ash settle and are flushed out through a pipe H. Part of the liquid is discharged through an over-flow pipe J, the remainder of the liquid returning into the mixing vat B through holes K, so as to be again subjected to the action of the agitating and mixing apparatus. This circulation of the liquor is a typical feature of the invention, and is indicated by arrows in the diagram.—*May 15th*, 1924.

MISCELLANEOUS.

215,169. April 9th, 1923.—CONTROL VALVE FOR STILL ENGINES, W. J. Still, 19, Denbigh-road, Ealing, London, W. 13.

This valve is intended for insertion in the pipe connecting the boiler and the cylinder of Still engines, and is intended not to open until a predetermined steam pressure is attained, but can also be operated manually. The valve is of a simple spring-loaded type, in which the inlet is at A and the outlets to the cylinders at B B. C is the spring which keeps the valve shut until the required pressure is attained, while D is the hand opening gear. It is noteworthy that the first claim in the specification is for:—"An engine operated on one side of the piston by the explosion of a combustible and on the other side

Nº 215,169

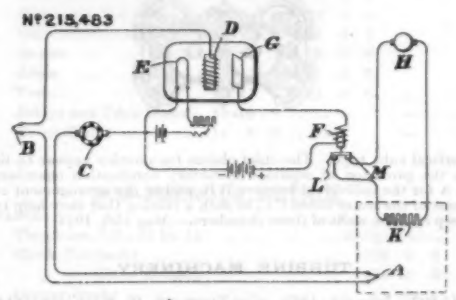


by the expansion of an elastic fluid under pressure generated by the waste heat of the products of combustion of the combustible, wherein the elastic fluid is prevented from passing to the engine until its pressure rises above a given value."—*May 8th*, 1924.

215,483. February 26th, 1923.—IMPROVEMENTS IN AND RELATING TO TEMPERATURE-OPERATED ELECTRIC RELAYS, The British Thomson-Houston Company, Limited, of Crown House, W.C. 2.

The drawing shows the invention as applied to the control of an electric oven A. The usual hot couple A, which is placed in the oven, and a cold couple B is placed at a suitable point outside the oven. In circuit with the thermo-couple is an interrupting device C, the function of which is to transmit in the form of pulsations the voltage set up by the thermo-couple. One

Nº 215,483

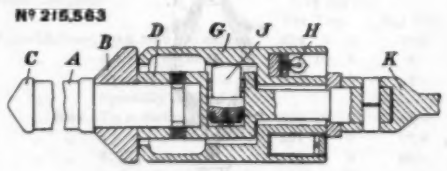


terminal of the thermo-couple is connected to the grid D of a three-electrode vacuum tube amplifier, while the other terminal of the thermo-couple is connected to the filament E of the amplifier. The terminals of the alternating-current relay F are connected to the filament and to the plate G respectively of the amplifier, the relay circuit being maintained at a constant potential by a battery. A heating circuit for the oven comprising a suitable generator H and resistance K is controlled by the alternating-current relay through contacts L and M. The action of the device is obvious.—*May 15th*, 1924.

215,563. May 3rd, 1923.—EARTH BORING APPARATUS, A. R. Mangnall, 43, Whitefriars, Chester.

The object of this invention is to allow the direction of a thrust bore to be varied, during progress, at will. At the rear end of the pilot bar A there is an additional head or collar B of larger dimensions than the pilot head C at the forward end of the boring bar. The tail end of the boring bar is adapted to be movably engaged by a block or fitting D, and this block is surrounded by a shell or cylinder G having an electric lamp H. The block contains a small hydraulic plunger J, which may be brought into contact with the interior of the shell or cylinder G when pressure is applied to the ram or plunger. The arrangement is

Nº 215,563



such that upon starting the bore the light H is arranged in line with a fixed telescope in the boring pit, and so long as the light remains in such alignment, the boring is proceeding smoothly and the shell or cylinder G behind the boring bar follows inoperative. When, however, the light moves out of alignment, say, to the right, this may be taken as an indication that the boring head is moving out of alignment to the left, and the block or fitting D is rotated from the boring pit until the plunger J presses against the left of the floating shell or cylinder G, thus moving the latter out of alignment, and imposing a counteracting force which tends to bring the boring head back to alignment.—*May 15th*, 1924.

INSTITUTION OF ELECTRICAL ENGINEERS.—With reference to the tentative programme in connection with the visit to this country of the delegates of overseas technical institutions in July next, which we published on page 610 of our issue of May 30th last, we have now received a corrected programme, in which, while in the main it is the same as the original document, we notice one change. The starting time of the special train for Cambridge on Saturday, July 12th, has been changed from 10.15 a.m. to 9.40 a.m. The train will start from King's Cross Station, L. and N.E. Railway.

Forthcoming Engagements.

Secretaries of Institutions, Societies, &c., desirous of having notices of meetings inserted in this column, are requested to note that, in order to make sure of its insertion, the necessary information should reach this office on, or before, the morning of the Wednesday of the week preceding the meetings. In all cases the TIME *and* PLACE *at which the meeting is to be held should be clearly stated.*

TO-DAY.

THE INSTITUTION OF LOCOMOTIVE ENGINEERS.—Wembley Exhibition. Summer Meeting. Assemble at the L.M.S. Stand, Railway Section. 10.15 a.m.

RADIO SOCIETY OF GREAT BRITAIN.—Institution of Electrical Engineers, Savoy-place, Victoria Embankment, London, W.C. 2. Informal meeting of the Transmitter and Relay Section. Discussion on "Tuning Coils," will be opened by Mr. A. J. Cooper. 6.30 p.m.

SATURDAY, JUNE 21ST.

NORTH OF ENGLAND INSTITUTE OF MINING AND MECHANICAL ENGINEERS.—Newcastle-upon-Tyne. General meeting. 2 p.m.

TUESDAY, JUNE 24TH.

INSTITUTION OF HEATING AND VENTILATING ENGINEERS.—Langham Hotel, Regent-street, London, W. 1. Summer meeting. 9.30 a.m.

TUESDAY TO THURSDAY, JUNE 24TH TO 26TH.

INSTITUTION OF GAS ENGINEERS.—Institution of Electrical Engineers, Savoy-place, London, W.C. 2. Annual general meeting. For programme see page 696.

WEDNESDAY, JUNE 25TH.

RADIO SOCIETY OF GREAT BRITAIN.—Institution of Electrical Engineers, Savoy-place, Victoria Embankment, London, W.C. 2. Lecture, "A *Résumé* of Modern Methods for the Measurement of Radio Signal Strength," by Mr. J. Hollingworth. 6 p.m.

TUESDAY TO SATURDAY, JUNE 24TH TO 28TH.

INSTITUTION OF NAVAL ARCHITECTS.—Summer meeting in London. For programme see page 628.

WEDNESDAY TO SATURDAY, JUNE 25TH TO 28TH.

INSTITUTION OF MUNICIPAL AND COUNTY ENGINEERS.—Annual general meeting in London. For programme see page 551.

THURSDAY, JUNE 26TH.

INSTITUTION OF ELECTRICAL ENGINEERS.—Natural History Museum, South Kensington, London, S.W. 7. Annual conversazione. 8.30 p.m.

SATURDAY, JUNE 28TH.

INSTITUTE OF BRITISH FOUNDRYMEN: LANCASHIRE BRANCH.—Visit to the works of the Sheepbridge Coal and Iron Company, Limited, near Chesterfield.

MANCHESTER GEOLOGICAL AND MINING SOCIETY.—Excursion to Castleton, Derbyshire, under the leadership of Professor Owen T. Jones.

MONDAY TO SATURDAY, JUNE 30TH TO JULY 12TH.

WORLD POWER CONFERENCE.—At the British Empire Exhibition, Wembley. For programme see page 126.

TUESDAY TO SATURDAY, JULY 1ST TO 5TH.

ROYAL AGRICULTURAL SOCIETY OF ENGLAND.—Eighty-third Annual Show at Leicester.

WEDNESDAY AND THURSDAY, JULY 2ND AND 3RD.

BRITISH WATERWORKS ASSOCIATION.—Annual general meeting at Sheffield. For programme see page 580.

MONDAY TO WEDNESDAY, JULY 7TH TO 9TH.

INSTITUTION OF MECHANICAL ENGINEERS.—Summer meeting in London. For programme see page 369.

THURSDAY, JULY 10TH.

KELVIN CENTENARY CELEBRATIONS.—Institution of Civil Engineers, Great George-street, London, S.W. 1. For programme see page 638. 4.30 p.m.

THURSDAY TO TUESDAY, JULY 10TH TO 15TH.

INSTITUTION OF ELECTRICAL ENGINEERS.—Visit of delegates of Overseas Technical Institutions. For programme see page 610.

FRIDAY, JULY 11TH.

KELVIN CENTENARY.—Connaught Rooms, Great Queen-street, London, W.C. 2. Banquet.

EMPIRE AUTOMOBILE CONFERENCE.—Under the joint auspices of the Society of Motor Manufacturers and Traders and the Institution of Automobile Engineers, an Empire Automobile Conference will take place on June 23rd in No. 3 Conference Hall, at the West End of the Palace of Industry, at the British Empire Exhibition. The Conference will consist of two sessions. At the morning session, which will commence at 11.30 a.m., a paper, entitled "The Requirements of the Colonial Market: The Technical Aspect," will be submitted by Mr. F. A. S. Acres. For the afternoon session, at 3 p.m., the paper for discussion is entitled "The Overseas Automobile Market: The Commercial Aspect," and the author is Mr. E. A. Rouch. The prize presented by the directors of Humbers, Limited, has been divided equally between the authors of the papers. All interested in the supply of British automobiles within the Empire are invited to attend and to take part in the discussions. Advance copies of the papers may be obtained on application to the offices of the Society of Motor Manufacturers and Traders in the Motor and Cycle Section (Palace of Engineering), or the secretary of the Society, 83, Pall-mall, S.W. 1, or from the secretary of the Institution of Automobile Engineers, Watergate House, Adelphi, W.C. 2.